30 / 10

BILL NO. S-77-11-44

SPECIAL ORDINANCE NO. S-273-77

AN ORDINANCE approving a contract with Hagerman Construction Corporation, for Water Works Improvements Wash Water Retention Basin Contract No. 77-W-1.

BE IT ORDAINED BY THE COMMON COUNCIL OF THE CITY OF FORT WAYNE, INDIANA:

SECTION 1. That the contract dated November 9, 1977, between the City of Fort Wayne, by and through its Mayor and the Board of Public Works and Hagerman Construction Corporation, for:

Water Works Imporvements Wash Water Retention Basin Contract No. 77-W-1.

for a total cost of $540,600.00, all as more particularly set forth in said onctract which is on file in the Office of the Board of Public Works and is by reference incorporated herein, made a part hereof and is hereby in all things ratified, confirmed and approved.

SECTION 2. This Ordinance shall be in full force and effect from and after its passage and approval by the Mayor.

Councilman

APPROVED AS TO FORM AND LEGALITY,

CITY ATTORNEY

Read the first time in full and on motion by Burns, seconded by Hunter, and duly adopted, read the second time by title and referred to the Committee on City Utilities (and the City Plan Commission for recommendation) and Public Hearing to be held after due legal notice, at the Council Chambers, City-County Building, Fort Wayne, Indiana, on _____, the _____ day of _____, 19__ at _____ o'clock _____ M., E.S.T.

DATE: 11-22-77

Charles W. Westerman
CITY CLERK

Read the third time in full and on motion by Burns, seconded by Hinga, and duly adopted, placed on its passage.

PASSED (LOST) by the following vote:

	AYES	NAYS	ABSTAINED	ABSENT	TO-WIT:
TOTAL VOTES	8	0		1	
BURNS	X				
HINGA	X				
HUNTER	X				
MOSES	X				
NUCKOLS	X				
SCHMIDT, D.	X				
SCHMIDT, V.				X	
STIER	X				
TALARICO	X				

DATE: 12-13-77

Charles W. Westerman
CITY CLERK

Passed and adopted by the Common Council of the City of Fort Wayne, Indiana, as (ZONING MAP) (GENERAL) (ANNEXATION) (SPECIAL) (APPROPRIATION) ORDINANCE (RESOLUTION) No. S-273-77 on the 13th day of December, 19 77

ATTEST: (SEAL)

Charles W. Westerman
CITY CLERK

John Nuckols
PRESIDING OFFICER

Presented by me to the Mayor of the City of Fort Wayne, Indiana, on the 14th day of December, 19 77 at the hour of 11:00 o'clock A M., E.S.T.

Charles W. Westerman
CITY CLERK

Approved and signed by me this 16th day of December, 19 77 at the hour of 1:00 o'clock P M., E.S.T.

Robert E. Armstrong
MAYOR

Dec 15
Col. of Works
Henry Wehrenberg

Bill No. S-77-11-44

REPORT OF THE COMMITTEE ON CITY UTILITIES

We, your Committee on City Utilities to whom was referred an Ordinance approving a contract with Hagerman Construction Corporation for Water Works Improvements Wash Water Retention Basin Contract No. 77-W-1

have had said Ordinance under consideration and beg leave to report back to the Common Council that said Ordinance Do PASS.

PAUL M. BURNS - CHAIRMAN

FREDRICK R. HUNTER - VICE CHAIRMAN

VIVIAN G. SCHMIDT

WINFIELD C. MOSES, JR.

JAMES S. STIER

DATE 12-13-77 CONCURRED IN

CHARLES W. WESTERMAN, CITY CLERK

65-137-12
11/9/77

CITY OF FORT WAYNE, INDIANA
WATER WORKS IMPROVEMENTS
WASH WATER RETENTION BASIN

Contract No. 77-W-1

CONTRACT DOCUMENTS
Bidding Documents
Specifications
and
Drawings

McNamee, Porter and Seeley
Consulting Engineers
Ann Arbor, Michigan

August 1977

Copy No. 4

CITY OF FORT WAYNE, INDIANA
WATER WORKS IMPROVEMENTS
WASH WATER RETENTION BASIN

Contract No. 77-W-1

CONTRACT DOCUMENTS
Bidding Documents
Specifications
and
Drawings

McNamee, Porter and Seeley
Consulting Engineers
Ann Arbor, Michigan

August 1977

D. Foland to appr Council 11/22/77

Prev. approval 11/5/77

Memorandum

To Board of Works Date Nov. 8, 1977

From D. L. Foland

Subject Approval of contracts, WaterWorks Improvements Wash Water Retention Basin, Contract #77-W-1

COPIES TO:

G. Patrick

E. Stanczak

Pursuant to bids being received on the above project on Oct. 19 and Contract being awarded by the Board to Hagerman Construction Corporation on Oct. 26, attached are 8 copies of the contract which has been executed by the officers of Hagerman Construction Corp. Also, attached is the original of the transmittal letter from Hagerman delivering the contracts and which is self-explanatory.

The attached contracts are submitted for execution by members of the Board of Public Works and the Mayor of the City of Fort Wayne, for attesting to the signatures by the Clerk of the Board of Works, approval as to form and legality by the City Attorney, and approval of the contract by the Common Council of the City of Fort Wayne.

Discussion regarding time table for this project with Mr. William L. Kerr, Assistant Secretary for Hagerman Construction Corp. indicates the advisability to request the Council's prior approval of this contract so that construction can commence yet this fall. Lengthy delays which may result through not obtaining prior approval, along with other factors, could jeopardize our meeting the construction schedule as required in our agreement with the Stream Pollution Control Board of the State of Indiana under Cause No.B-437. In that agreement, construction is to commence on or before Dec. 1, 1977.

If there are any questions regarding the attached contracts, or my assistance is needed in any presentation to the Council regarding this contract, I am at your disposal.

After final execution of these contracts and Council approval, please return all copies to this office, except the Board's copies and I will see to it that they are distributed to the interested parties.

D. L. Foland

D. L. Foland, P.E.
Chief Water Engineer

DLF/klr

attachments

65-137-12
11/9/77

Hagerman Construction Corporation

GENERAL CONTRACTORS

219-424-1470

Office: 403 Strauss Building · Phone [redacted]

P.O. Box 690

FORT WAYNE, INDIANA 46801

November 8, 1977

City of Fort Wayne
% D. L. Foland P.E.
Chief Water Engr.
7th Floor
City-County Building
One Main St.
Fort Wayne, Indiana 46802

Re: Water Works Improvements
Wash Water Retention Basin
Contract No. 77-W-1

Gentlemen:

We are hand delivering this date eight (8) copies of the Contract Documents for the "City of Fort Wayne Indiana, Water Works Improvements, Wash Water Retention Basin, Contract 77-W-1" which have been duly signed by officers of our corporation.

Also enclosed therewith please find eight (8) copies of the Certificate of Insurance for the various coverages from USF & G and also eight (8) copies of letter from Yaste, Zent & Rye Inc. pertaining to the Builders Risk insurance and the Owners Protective Liability insurance which will be delivered at a future date upon receipt thereof.

Very truly yours,

HAGERMAN CONSTRUCTION CORPORATION

By William L. Kerr, Ass't. Secretary

WLK:bls
Encls.
cc: McNamee, Porter & Seeley

CONTENTS

	Page
ADVERTISEMENT	v
INSTRUCTIONS TO BIDDERS	vi
PROPOSAL	x
EQUIPMENT QUESTIONNAIRE	xiii
BIDDER'S BOND	xvii
LEGAL STATUS OF BIDDER	xviii
NON-COLLUSION AFFIDAVIT	xix
GENERAL FORM NO. 96-A	xx
CERTIFICATE IN LIEU OF FINANCIAL STATEMENT	xlii
CERTIFICATE IN LIEU OF EQUAL EMPLOYMENT STATEMENT AND AFFIRMATIVE ACTION PROGRAM	xliii
INSTRUCTIONS TO BIDDERS – EQUAL EMPLOYMENT OPPORTUNITY – AFFIRMATIVE ACTION PROGRAM	xliv
AGREEMENT	l
INSTRUCTIONS FOR EXECUTING AGREEMENT	lviii
PERFORMANCE AND GUARANTY BOND	lix
WAGE RATE SCALE	lxii

SPECIFICATIONS

Section		
1.	General Requirements	1-12
2.	Earthwork	1-2
3.	Concrete	1-15
4.	Metals	1-4
5.	Moisture Protection	1-2
6.	Finishes	1-5
7.	Site Improvements and Restoration Work	1-3
8.	Pipe Work	1-17
9.	Valves and Gates	1-9

(continued)

CONTENTS

		Page
10.	Special Pumps	1-5
11.	Mechanical Insulation	1-2
12.	Plumbing, Heating, Ventilating and Air Conditioning	1-8
13.	Electrical	1-31
14.	Instrumentation	1-15
15.	Piling	1-3

ADVERTISEMENT

City of Fort Wayne, Indiana

Water Works Improvements

Wash Water Retention Basin

Contract No. 77-W-1

Sealed proposals will be received by the Board of Public Works of the City of Fort Wayne, in the State of Indiana at their office in the City County Building, One Main Street, Fort Wayne, Indiana, 46802 up to 2:00 P.M., prevailing local time on the 19th day of October, 1977, at which hour the proposals will be publicly opened and read aloud for the construction of Contract 77-W-1.

The work consists of construction of a 200,000 gallon covered concrete tank and pump room and furnishing and installation of pumping units, pipe, valves and other related equipment.

The Drawings and Specifications under which the work is to be done are on file and may be examined at the office of the Board of Public Works; Dodge Reports and/or Builders and Traders Exchange at Fort Wayne, South Bend and Indianapolis, Indiana, and Lansing and Grand Rapids, Michigan; and at the office of McNamee, Porter & Seeley, Consulting Engineers, 2223 Packard Rd., Ann Arbor, Michigan 48104.

Drawings and Specifications may be obtained from the Consulting Engineers by making a deposit of Fifty Dollars ($50.00) per set. The full amount of the deposit will be refunded to each bidder for the one set of Documents upon which a bona fide proposal is submitted to the Owner. For additional sets for bidders use and for nonbidders, including subcontractors, Forty Dollars ($40.00) will be refunded for each set of Documents returned in good condition (unmarked) within ten (10) days after the bidding date.

Excerpts of Drawings and Specifications for use of suppliers, manufacturers' representatives, etc., may be obtained on request from the Consulting Engineers at no charge.

A certified check or bidder's bond for a sum of not less than five percent (5%) of the amount of the proposal will be required with each proposal.

The right is reserved by the Owner to accept any proposal, to reject any proposal, and to waive irregularities in proposals.

No bids may be withdrawn after the above date and time for receiving bids for a period of ninety (90) days.

All conditions covered under "Instructions to Bidders" as appearing in the plans and specifications are to be met by bidders in submitting their bids to the Board of Public Works.

The successful bidder must furnish a certificate from the Industrial Board of Indiana, showing that he has complied with the provisions of Section 5, 68 and 69 of the Indiana Workmen's Compensation Act (Acts of the General Assembly of the State of Indiana, 1929, page 536).

CITY OF FORT WAYNE, INDIANA
BOARD OF PUBLIC WORKS:

Henry P. Wehrenberg, Chairman
Ethel H. LaMar
Max G. Scott
Ursula Miller, Clerk

INSTRUCTION TO BIDDERS

SCOPE OF WORK

The work under this Contract includes the furnishing of all labor, materials, equipment and construction equipment necessary for the construction of filtration plant improvements as set forth in the Advertisement, all complete and in accordance with the Drawings and specifications.

SUB-SOIL CONDITIONS

No soil borings have been made for the present contract. Soil borings were made for the original filtration plant construction (1931) and for additions to the filtration plant (1953) and copies of this soil information are on file and may be examined at the Three Rivers Filtration Plant and at the office of McNamee, Porter and Seeley, 2223 Packard Road, Ann Arbor, Michigan.

This information is offered to the bidder as evidence and the bidder himself shall assume the entire responsibility for any conclusions which he may draw from it. The Owner does not guarantee, however, that the ground encountered during construction will conform with these samples and the bidders should secure such other information as they may consider necessary to check and supplement the above date.

QUESTIONNAIRE AND FINANCIAL STATEMENT

In conformity with the provisions of an act of the General Assembly of the State of Indiana, Chapter 202, Page 680, Acts of 1929, each bidder is required to submit under oath, with and as part of his bid a statement of his experience, his proposed plan for performing the work, the equipment which he has available for the performance of such work and a financial statement of his business. The statements to be required must be submitted on forms prescribed by the State Board of Accounts, copies of which are included with the proposal and designated, collectively, as General Form No. 96-A. Any Contractor who has already filed Form 96-A with the Fort Wayne Board of Public Works is permitted to submit a certificate in lieu of financial statement.

NAME, ADDRESS AND LEGAL STATUS OF BIDDER

The name and legal status of the bidder, that is, a corporation, partnership, or an individual shall be stated in the proposal. A corporation bidder shall name the state in which its articles of incorporation are held and must give the title of the official having authority, under the by-laws, to sign contracts. A partnership bidder shall give the full names and addresses of all partners.

Anyone signing a proposal as an agent of another or others must submit with his proposal legal evidence of his authority to do so.

The place of residence of the bidder, or the office address in the case of a firm or company, with county and state, must be given after his signature.

BID DEPOSITS

Each proposal must be accompanied by a bid deposit in the form of a certified check or bidder's bond for a sum of not less than five percent (5%) of the amount of the proposal drawn upon some bank in goodstanding, or issued by a surety company authorized to do business in Indiana, as a guarantee on the part of the bidder that he will, if called upon to do so, enter into contract, in the attached form, to do the work covered by such proposal, and at the prices stated therein and to furnish acceptable surety for its faithful and entire fulfillment. Such certified check or bidder's bond shall be made out to the Owner, and shall be subject to the conditions specified in the proposal.

RETURN OF BID DEPOSITS

The bid deposits of all except the three lowest bidders will be returned within three days after the opening of bids. The bid deposits of the three lowest bidders will be returned within 48 hours after the executed contract and the required bonds have been finally approved by the Owner or after rejection of all bids.

FORM OF PROPOSAL
All proposals must be made and signed by the bidder in the form attached hereto and without removal from the bound bood. Additional copies of the proposal form for the bidder's files may be obtained upon request at the office of the Engineer.

All prices stated in the proposal must be plainly written in legible words and/or figures. Illegibility of any word and/or figure in the proposal may be sufficient cause for rejection of the proposal by the Owner.

Each proposal must be enclosed in a sealed envelope addressed to and labeled as follows:

Addressed to:	Board of Public Works City - County Bldg. One Main Street Fort Wayne, IN 46802	Labeled as:	Proposal for Wash Water Retention Tank Contract No. 77-W-1

BASIS OF PROPOSAL
Proposals are solicited on the basis of a lump sum for the work complete, with a subdivision of this lump sum price among the various classes of work as provided.

The bidder shall name a manufacturer or subcontractor for each of the items in the base proposal where blanks are provided. Other makes of equipment shall be bid using the Proposal page entitled "Alternates to the base proposal are offered as follows," stating the separate and respective amounts that will be deducted from, or added to, the lump sum price.

Bidders shall complete all deductible alternates listed in the proposal stating the respective amounts that will be deducted from the base proposal contract lump sum if work is deleted at time of award.

Bidders shall submit differential unit prices as listed in the proposal. These prices will be used in the preparation of Change Orders for alterations in the work.

Failure to complete the base proposal deductible alternatives anddifferential unit prices will make the proposal subject to rejection by the Owner.

PROPOSAL DATA
Where equipment manufacturers are required to be listed in the base proposal or the equipment questionnaire the bidders must bid on equipment by manufacturers as suggested in the Specifications, or equal. For equipment items and materials not requiring manufacturers names in the base proposal and equipment questionnaire, bidders shall offer equipment meeting the requirements of the technical specifications.

EQUIPMENT QUESTIONNAIRE
Within forty-eight (48) hours after the receipt of bids the two low bidders shall furnish the Engineer the Equipment Questionnaire stating the names of the manufacturers of equipment which they proposed to furnish.

INTERPRETATION OF CONTRACT DOCUMENTS
Neither the Owner nor Engineer will give verbal answers to any inquiries regarding the meaning of drawings and specifications, or verbal instructions prior to the award of the Contract. Any verbal statement regarding same by any persons, prior to the award, shall be unauthoritative.

Any explanation desired by bidders must be requested of the Engineer in writing not less than 5 days prior to the bidding date and, if explanation is necessary a replay will be made in the form of an addendum, a copy of which will be forwarded to each prospective bidder who has received a set of the contract documents and to such other interested parties as have requested that they be furnished with a copy of each addendum.

All addenda issued to bidders prior to date of receipt of bids shall become a part of these specifications and all bids are to include the work therein described. Each proposal submitted shall list all addenda by numbers which have been received prior to time scheduled for receipt of bids. In addition, a signed copy of each addendum shall be submitted with the signed proposal.

PERFORMANCE BOND
The successful bidder will be required to execute a Performance Bond in the form attached hereto with sureties acceptable to the Owner; the Performance Bond is to be executed to the Owner, to be in the amount of one hundred percent (100%) of the full contract price, and to be conditioned for the faithful fulfillment of the contract and to include the protection of the Owner from all liens and damages arising out of the work.

INSURANCE
Insurance of the several kinds spelled out in the Agreement shall be carried by the Contractor.

RIGHT TO ACCEPT, TO REJECT, AND TO WAIVE DEFECTS
The Owner reserves the right to accept any proposal, to reject any or all proposals, and to waive defects or irregularities in any proposal. In particular, any alteration, erasure or interlineation of the contract documents and of the form of proposal shall render the accompanying proposal irregular and subject to rejection by the Owner.

WITHDRAWAL OF BIDS
Any bidder who has submitted a proposal to the Owner may withdraw his bid at any time prior to the scheduled time for the receipt of bids. No bidder may withdraw his bid after the time stated in the advertisement for receiving bids, and his bid shall be firm and shall remain firm for a period of ninety (90) days thereafter.

LOCAL LABOR
The bidder's attention is particularly directed to the paragraph regarding the use of local labor under "General Requirements" and "Agreement".

TIME AND LIQUIDATED DAMAGES
Bidder's attention is directed to the Time and Liquidated Damages articles in the Agreement.

TAXES
The Contractor shall pay all sales, use and other taxes that are lawfully assessed against the Owner or Contractor in connection with the work included in this contract.

EQUIPMENT DATA SHEET
Prior to the receipt of bids for this contract, the manufacturers of each equipment item, for which a data sheet is included in the Specifications, shall complete and submit to the Engineer the equipment data sheet, together with any supplemental information required. The purpose of these data sheets is to furnish the Owner the information necessary to evaluate the equipment proposed. Exceptions to the specifications will not be allowed unless covered by addendum and presubmittal information will not supersede specification requirements. Failure by a manufacturer to furnish all the information requested shall make his equipment subject to rejection by the Owner.

AWARD AND EXECUTION OF CONTRACT
Contract shall be awarded to the lowest responsive and responsible bidder on the basis of the base proposal total contract lump sum.

The contract shall be deemed as having been awarded when formal notice of award shall have been duly served by the Owner upon the bidder.

The bidder to whom the contract shall have been awarded will be required to execute the Agreement in the form attached hereto and to furnish surety and insurance certificates all as required. In case of his refusal or failure to do so within ten days after the award, he will be considered to have abandoned all his rights and interests in the award, and his bid deposit may be declared forfeited to the Owner as liquidated damages and the work may be awarded to another.

WAGE SCALES

The successful bidder will be required to pay, and shall require all sub-contractors to pay wage rates on this work which will not be less than the prescribed scale of wages as determined pursuant to the provisions of Chapter 319 of the Acts of the General Assembly of Indiana of 1935.

INDIANA WORKMEN'S COMPENSATION ACT CERTIFICATE

The successful bidder must furnish a certificate from the Industrial Board of Indiana showing that he has complied with the provisions of Sections 5, 68 and 69 of the Indiana Workmen's Compensation Act (Acts of the General Assembly of the State of Indiana, 1929, Page 536).

EQUAL EMPLOYMENT OPPORTUNITY

Each bidder is required to have on file with the Equal Employment Opportunity Office of the City of Fort Wayne, Indiana an Equal Employment Statement and an Affirmative Action Program. Instructions to Bidders regarding Equal Employment Opportunity - Affirmative Action Program are included with these Contract Documents for the bidders use. Additional copies of the forms are available upon request from the Engineer or the Equal Employment Opportunity Office of the City of Fort Wayne, Indiana. Each proposal must be accompanied with the "Certificate in Lieu of Equal Employment Statement and Affirmative Action Program", included in these Contract Documents.

SEQUENCE OF CONSTRUCTION

The Contractor shall so arrange his work that at no time will it cause any unnecessary interruption to the operation of existing treatment facilities. The Contractor shall not take out of service any of the existing equipment until obtaining the approval of the Engineer. A suggested sequence of construction is as follows:

1. In general, the wash water retention basin tank, the pump room including equipment and the overflow drain line can be constructed with little or no interruption to the operation of the present water treatment plant.

2. Connection to the existing 36-inch wash water drain line cannot be made until valve B-1-1 and sluice gate S-1-1 have been installed. The connection must be scheduled in coordination with operating personnel at the Filtration Plant. A minimum of 72 hours notification must be given by the Contractor before commencing the connection. This work must be completed in a maximum time of 10 hours.

3. The 12-inch wash water return line and pumps must be installed complete prior to blocking of the existing 36-inch wash water drain line, in the west end of the existing filter gallery.

   a) The connection(s) of the 12-inch return line at the East Plant secondary flume must be coordinated with operating personnel at the filtration plant. This work must necessarily be scheduled at periods of low water demand. Filtration plant operating personnel will lower the water surface in the East Plant, one segment at a time, to allow the Contractor to work at or in the flumes in the dry.

   b) At the west end of the existing filter gallery, the Contractor shall break through the floor and make all preparations necessary and have all tools, equipment, labor and everything necessary to knock out and plug the 36 inch drain line within a 10 hour period. Contractor shall give filtration plant operating personnel a minimum of 72 hours notice prior to blocking of the 36-inch line.

PROPOSAL

TO: The Mayor and the Board of Public Works
City - County Building
One Main Street
Fort Wayne, Indiana 46802

The undersigned, having familiarized themselves with the local conditions affecting the cost of the work, and with the Contract Documents, including Advertisement, Instructions to Bidders, Proposal, Agreement, Bonds, General Requirements, Specifications, and Drawings, on file in the offices of the Owner and the Consulting Engineers, hereby propose to perform everything required to be performed and to provide and furnish all labor, materials, necessary tools, expendable equipment, and all utility and transportation services necessary to perform and complete in a workmanlike manner all of the work required, all in accordance with the plans and specifications entitled:

City of Fort Wayne, Indiana
Water Works Improvements
Wash Water Retention Basin
Contract 77-W-1

prepared by McNamee, Porter and Seeley, Consulting Engineers, including Addenda No's. _____, _____, _____, and _____, issued thereto, at and for the contract sum(s) as set forth below:

For the work complete, the base proposal total contract lump sum of:

_____

_____

_____ Dollars ($_____).

The base proposal contract lump sum is subdivided as follows:

General Requirements	$_____
Earthwork	$_____
Concrete	$_____
Metals	$_____
Moisture Protection	$_____
Finishes	$_____
Site Improvements	$_____
Pipe Work	$_____

(continued)

Valves and Gates $ _____

Special Pumps $ _____

Manufactured by: _____

Mechanical Insulation $ _____

Plumbing, Heating and Ventilating $ _____

Electrical $ _____

Instrumentation $ _____

Piling $ _____

Based on estimated length of 1740 lineal feet of unreinforced piles, 1660 lineal feet of reinforced piles and one uplift load test

Subcontractor _____

DIFFERENTIAL UNIT PRICES

The undersigned proposes the following unit prices for work as identified below:

All total prices must be written in words as well as expressed by figures. Prices for supplies and materials, and work and labor shall be expressed by figures.

When the total quantity of piling actually driven varies from the total estimated length of feet (with no changes in the number of piles), differential unit prices are offered as follows:

A. For additional unreinforced piling, per lineal foot, add the unit price of _____ _____ Dollars ($_____).

Price for Supplies and Materials ($ _____) Price for Work and Labor ($ _____).

B. For additional reinforced piling, per lineal foot, add the unit price of _____ _____ Dollars ($_____).

Price for Supplies and Materials ($ _____) Price for Work and Labor ($ _____).

C. For less unreinforced piling, per lineal foot, deduct the unit price of _____ _____ Dollars ($_____).

Price for Supplies and Materials ($ _____) Price for Work and Labor ($ _____).

D. For less reinforced piling, per lineal foot, deduct the unit price of _____ _____ Dollars ($_____).

Price for Supplies and Materials ($ _____) Price for Work and Labor ($ _____).

E. For additional pile uplift load tests, each, add the unit price of _____ _____ Dollars ($_____).

Price for Supplies and Materials ($ _____) Price for Work and Labor ($ _____).

Alternates to the base proposal are offered as follows:

Section	Item
_____	_____
	Alternate Manufacturer: _____
	Alternate Material: _____
	Add: _____ Deduct: _____
_____	_____
	Alternate Manufacturer: _____
	Alternate Material: _____
	Add: _____ Deduct: _____
_____	_____
	Alternate Manufacturer: _____
	Alternate Material: _____
	Add: _____ Deduct: _____
_____	_____
	Alternate Manufacturer: _____
	Alternate Material: _____
	Add: _____ Deduct: _____
_____	_____
	Alternate Manufacturer: _____
	Alternate Material: _____
	Add: _____ Deduct: _____

EQUIPMENT QUESTIONNAIRE

Within forty-eight (48) hours after the receipt of bids the two low bidders shall furnish the Engineer in the spaces provided the names of the manufacturers of equipment which he proposes to furnish. Upon award of a contract, the named equipment shall be furnished. Substitutions will be permitted only if named equipment does not meet the specifications or the manufacturer is unable to meet delivery requirements of the construction schedule.

Preliminary acceptance of equipment listed by manufacturer's name shall not in any way constitute a waiver of the specifications covering such equipment; final acceptance will be based on full conformity with the specifications covering the equipment.

Section	Equipment Item	Manufacturer
	Special Pumps - Abrasive	
	Service Pumps	_____

The undersigned attaches hereto the following statements of the nature and in the form as required by the Instructions to Bidders: Affidavit of Non-Collusion, Experience Questionnaire, Plan and Equipment Questionnaire and Financial Statement.

The undersigned hereby agrees if the foregoing proposal shall be accepted by the Owner, he will, within ten (10) consecutive calendar days after receiving notice of the acceptance of such proposal, enter into contract, in the appropriate form, to furnish the labor, materials, equipment, tools and construction equipment necessary for the full and complete execution of the work, at and for the prices named in his proposal, and he will furnish to the Owner the required performance bond and such certificates of compliance with provisions of the Indiana Workmen's Compensation Act of 1929 as shall be approved and accepted by the Owner.

The undersigned hereby agrees that if this foregoing proposal shall be accepted by the Owner, he will complete the entire work of this contract within 200 consecutive calendar days after being notified to proceed with the work.

The undersigned attached hereto a (certified check - Bidder's bond) in the sum of _____ Dollars ($_____) as required in the Instructions to Bidders and the undersigned agrees that in case he shall fail to fulfill his obligations under the foregoing Proposal, then the Owner may, at his option, determine that the undersigned has abandoned his rights and interests in such proposal and that the certified check or bidder's bond accompanying his proposal, has been forfeited to the Owner; but otherwise the said certified check or bidder's bond shall be returned to the undersigned upon the execution of such contract and the acceptance of his bond or upon the rejection of his proposal.

In submitting this bid, it is understood that the right is reserved by the Owner to reject any and all bids.

IN TESTIMONY WHEREOF, THE BIDDER HAS HEREUNTO SET HIS HAND THIS _____ DAY OF _____, 197 __.

_____

IN WITNESS WHEREOF, the bidder (a firm) have hereunto set their hands and seals this _____ day of _____, 197 ___.

FIRM NAME_____

By_____

_____

IN TESTIMONY WHEREOF, the bidder (a corporation) has caused this proposal to be signed by its President and Secretary and affixed its corporate seal this _____ day of _____, 197 ___.

_____
Name of Corporation

_____
President

_____
Secretary

NOTE 1. If the bidder is a corporation, it is incorporated under the laws of the State of _____.

If the bidder's proposal is accepted, the contract will be signed by:

TITLE:_____

TITLE:_____

NOTE 2. Use this form if cashier's or certified check accompanies bid: Enclosed herewith find cashier's or certified check for $_____ being 10% of the maximum bid herein, made payable to:

_____.
Name of Officer and Municipality

the proceeds of which are to remain the absolute property of said

_____
Municipality

if _____
Bidder

shall not within ____ days after notice of acceptance of the within bid, enter into a written contract, and secure said contract by a bond for the full amount of the contract to the approval of the proper officials of said

_____
Municipality

NOTE 3. Use this form if bidder's bond accompanies bids.

Enclosed herewith find a bidder's bond in an amount equal to a ten (10%) percent of maximum bid herein, subject to the approval of the Board of Public Works, conditioned as follows: That if the Board of Public Works shall award _____ the contract for said work, and if _____ shall enter into a contract and furnish a 100% Performance Bond as required within 10 days from the date, he is notified of the acceptance of his bid, then the obligation of said bond shall be null and void, otherwise to remain in full force and effect.

TO BE EXECUTED BY BIDDER AND SURETY COMPANY BEFORE DEPOSITING BID:

BIDDER'S BOND

Know All Men by These Presents:

That WE, _____ as principal

and _____

and _____ as sureties,

are held and firmly bound unto the City of Fort Wayne, Indiana, in the sum

of _____ DOLLARS ($_____),

to be paid to the said City of Fort Wayne, Indiana, or its successors or assigns, for the payment of which, well and truly made, we hereby bind ourselves, our heirs, successors, executors and administrators, jointly and severally, firmly by these presents.

Signed and sealed at _____, this _____ day of _____, 197___.

The condition of this obligation is such that if the accompanying bid or proposal of _____

_____

made this day to the City of Fort Wayne, State of Indiana, is accepted, and the contract awarded to the above bidder, and the bidder shall, within ten (10) days after such award is made, enter into a contract with the City of Fort Wayne, State of Indiana, for the work bid upon, and give bond as required; then this obligation shall be null and void; otherwise, it shall remain in full force and effect.

SIGNED at _____

this _____ day of _____, 197___.

_____ _____

_____ _____

Principal Surety

LEGAL STATUS OF BIDDER

A corporation duly organized and doing business under the laws of the State of _____ for whom _____, bearing the official title of _____ whose signature is affixed to this proposal, is duly authorized to execute contracts.

A partnership, all of the members of which, with addresses, are:

_____

_____

_____

An individual, whose signature is affixed to this proposal.

(The bidder shall fill out the appropriate form and strike out the other two.)

NON-COLLUSION AFFIDAVIT

The Bidder, by its officers and _____

_____

agents or representatives present at the time of filing this bid, being duly sworn on their oaths, say that neither they nor any of them have in any way, directly or indirectly, entered into any arrangement or agreement with any other bidder, or with any public officer of such City of Fort Wayne, Indiana, whereby such affiant or affiants or either of them, has paid or is to pay to such other bidder or public officer any sum of money, or has given or is to give such bidder or public officer anything of value whatever, or such affiant or affiants or either of them has not directly or indirectly, entered into any arrangement or agreement with any other bidder or bidders, which tends to or does lessen or destroy free competition in the letting of the contract sought for by the attached bids, that no inducement of any form or character other than that which appears upon the face of the bid will be suggested, offered, paid or delivered to any person whomsoever to influence the acceptance of the said bid or awarding of the contract, nor has this bidder any agreement or understanding of any kind whatsoever, with any person whomsoever to pay, deliver to, or share with any other person in any way or manner, any of the proceeds of the contract sought by this bid.

_____

_____

_____

Subscribed and sworn to before me by _____

this _____ day of _____, 197___.

My Commission Expires:

_____ _____

Notary Public

Subscribed and sworn to before me by _____

this ____ day of _____, 197___.

My Commission Expires:

_____ _____

Notary Public

Subscribed and sworn to before me by _____

this ____ day of _____, 197___.

My Commission Expires:

_____ _____

Notary Public

GENERAL FORM NO. 96-A

Prescribed by the

STATE BOARD OF ACCOUNTS OF INDIANA

STANDARD QUESTIONNAIRES AND
FINANCIAL STATEMENT FOR BIDDERS

Prescribed by the

STATE BOARD OF ACCOUNTS OF INDIANA

For use in investigating and determining the qualifications of bidders on public construction when the aggregate cost of any such work or improvement will be Five Thousand Dollars or more.

These statements to be submitted under oath by each bidder with and as a part of his bid, as provided by Chapter 306, Page 1248, Acts of 1947 *

Submitted to _____

By _____ (A Corporation / A Co-Partnership / An Individual)

Address _____

_____

Filed _____

_____

_____

* AN ACT concerning the awarding of contracts for the performance of public work and authorizing the Board of Accounts to prescribe certain forms to be used in ascertaining the responsibility of contractors who submit bids for the performance of such work.

EXPERIENCE QUESTIONNAIRE AND

PLAN AND EQUIPMENT QUESTIONNAIRE

Submitted by _____ (An Individual / A Co-Partnership / A Corporation)

With Principal Office at _____

Submitted to _____

EXPERIENCE QUESTIONNAIRE

The signatory of this Questionnaire guarantees the truth and accuracy of all statements and of all answers to interrogatories hereinafter made.

1. How many years has your organization been in business as a general contractor under your present business name?

   _____

2. How many years experience in construction work has your organization had?

   _____

   (a) As a general contractor? _____

   (b) As a sub-contractor? _____

3. What projects has your organization completed?

Contract Amt.	Class of Work	When Completed	Name & Address of Owner

3A. What projects has your organization now in process of construction?

Contract Amt.	Class of Work	When Completed	Name & Address of Owner

4. Have you ever failed to complete any work awarded to you?

_____

If so, where and why? _____

_____

_____

_____

5. Has any officer or partner of your organization ever been an officer or partner of some other organization that failed to complete a construction contract?

_____

If so, state name of individual; other organization and reason therefor:

_____

_____

_____

6. Has any officer or partner of your organization ever failed to complete a construction contract handled in his own name?

_____

If so, state name of individual, other organization and reason therefor:

_____

_____

_____

7. In what other lines of business are you financially interested?

_____

_____

_____

8. For what corporations or individuals have you performed work, and to whom do you refer?

_____

9. For what cities have you performed work and to whom do you refer?

10. For what counties have you performed work and to whom do you refer?

11. For what State Bureau or Departments have you performed work and to whom do you refer?

12. Have you ever performed any work for the U. S. Government?

_____

If so, when and to whom do you refer? _____

_____

_____

_____

_____

_____

_____

13. What is the construction experience of the principal individuals of your organization?

Individual's Name	Present Position or Office	Years of Construction Experience	Magnitude and Type of Work	In What Capacity

PLAN AND EQUIPMENT QUESTIONNAIRE

The signatory of this questionnaire guarantees the truth and accuracy of all statements and of all answers to interrogatories hereinafter made.

1. In what manner have you inspected this proposed work? Explain in detail.

_____

_____

_____

_____

2. Explain your plan or layout for performing the proposed work?

_____

_____

_____

_____

_____

3. The work, if awarded to you, will have the personal supervision of whom?

_____

_____

*4. Do you intend to do the hauling on the proposed work with our your forces?

_____

If so, give amount and type of equipment to be used:

_____

_____

_____

_____

_____

*5. If you intend to sublet the hauling or perform it through an agent, state amount of sub-contract or agent's contract, and, if known, the name and address of sub-contractor or agent, amount and type of his equipment and financial responsibility.

_____

_____

_____

_____

* Items 4, 5, 6 and 7 may not be applicable in all building contracts; if not, omit.

*6. Do you intend to do the grading on the proposed work with your own forces?

_____

If so, give type of equipment to be used:

_____

_____

*7. If you intend to sublet the grading or perform it through an agent, state amount of sub-contract or agent's contract, and, if known, the name and address of sub-contractor or agent, amount and type of his equipment, and financial responsibility.

_____

_____

_____

_____

_____

_____

8. Do you intend to sublet any other portions of the work?

_____

_____

_____

If so, state amount of sub-contract, and, if known, the name and address of the sub-contractor, amount and type of his equipment and financial responsibility:

_____

_____

_____

_____

_____

9. From which sub-contractors or agents do you expect to require a bond?

_____

_____

_____

_____

_____

_____

10. What equipment do you own that is available for the proposed work?

Quantity	Item	Description, Size Capacity, Etc.	Condition	Years of Service	Present Location

11. What equipment do you intend to purchase for use on the proposed work, should the contract be awarded to you?

Quantity	Item	Description, Size Capacity, Etc.	Approximate Cost

12. How and when will you pay for the equipment to be purchased?

_____

_____

13. Do you propose to rent any equipment for this work?

_____

If so, state type, quantity and reason for renting:

_____

_____

_____

_____

_____

14. Have you made contracts or received firm offers for all materials within prices used in preparing your proposal? Do not give name of dealers or manufacturers.

_____

_____

_____

_____

Dated at _____ This _____ day of

_____, 19___.

_____
Name of Organization

By _____

_____
Title of Person Signing

STATE OF _____)
) SS
COUNTY OF _____)

_____ being duly sworn deposes

and says he is _____

of the above _____
Name of Organization

and that the answers to the questions in the foregoing questionnaires and all statements therein contained are true and correct.

Subscribed and sworn to before me this

_____ day of

_____, 19___.

_____
Notary Public

My Commission expires _____

CONTRACTOR'S FINANCIAL STATEMENT

Submitted by: _____ (An Individual / (A Co-Partnership / (A Corporation

With principal office at _____

Conditions at Close of Business _____ 19____

Assets	Elsewhere	Dollars & Cents
1. Cash: (a) on hand $_____ (b) in Bank $_____ (c) $_____		
2. Notes Receivable (a) Due within 30 days _____		
(b) Due after 90 days _____		
(c) Past due _____		
3. Accounts receivable from completed contracts, exclusive of claims not approved for payment _____		
4. Sums earned on uncompleted contracts as shown by Engineer's or Architect's estimate (a) Amount receivable after deducting retainage _____		
5. Accounts receivable from sources other than construction contracts _____		
6. Deposits for bids or other guarantees:		
(a) Recoverable within 90 days _____		
(b) Recoverable after 90 days _____		
7. Interest accrued on loans, securities, etc. _____		
8. Real Estate:		
(a) Used for Business purposes _____		
(b) _____		
9. Stocks & Bonds: (a) Listed-present market value _____		
(b) Unlisted-present market value _____		
10. Materials in stock not included in Item 4 (a) for uncompleted contracts (present value) _____		
(b) Other materials (present value) _____		
11. Equipment, book value _____		
12. Furniture & Fixtures, book value _____		
13. Other Assets _____		
	TOTAL ASSETS	

LIABILITIES

	Amount
1. Notes Payable:	
(a) To Banks regular	
(b) To Banks for certified checks	
(c) To others for equipment obligations	
(d) To others exclusive of equipment obligations	
2. Accounts Payable:	
(a) Not past due	
(b) Past due	
3. Other Liabilities	
4. Reserves	
5. Capital Stock paid up:	
(a) Common	
(b) Common	
(c) Preferred	
(d) Preferred	
6. Surplus (net worth)	
TOTAL LIABILITIES	

CONTINGENT LIABILITIES

1. Liability on notes receivable, discounted or sold _____
2. Liability on accounts receivable, pledged, assigned or sold _____
3. Liability as bondsman _____
4. Liability as guarantor on contracts or on accounts of others _____
5. Other contingent liabilities _____

TOTAL LIABILITIES _____

DETAILS RELATIVE TO ASSETS

1. Cash
   (a) On Hand _____ $ _____
   (b) Deposited in banks named below _____ _____
   (c) Elsewhere-(State where) _____ _____

Name of Bank	Location	Deposit in Name of	Amount

2. *Notes Receivable
   (a) Due within 90 days _____ $ _____
   (b) Due after 90 days _____ $ _____
   (c) Past Due _____ $ _____

Receivable From Name and Address	For What	Date of Maturity	How Secured	Amou Amount

Have any of the above been discounted or sold? _____
If so, state amount, to whom, and reason _____

3. *Accounts receivable from completed contracts exclusive of claims not approved for payment _____ $ _____

Name & Address of Owner	Nature of Contract	Amount of Contract	Amount Receivable

Have any of the above been assigned, sold or pledged? _____
If so, state amount, to whom, and reason _____

*List separately each item amounting to ten percent or more of the total and combine the remainder.

Sums earned on uncompleted contracts as shown by Engineer's or Architect's estimate:

4. *(a) Amount receivable after deducting retainage $_____

(b) Retainage to date due upon completion of Contract $_____

Designation of Contract and Name & Address of Owner	Amount of Contract	Amount Earned	Amount Received	Retainage When Due Amount	Amount Exclusive of Retainage

Have any of the above been sold, assigned, or pledged?

If so, state amount, to whom, and reason_____

5. *Accounts receivable not from construction contracts $_____

Received From	Name & Address	For What	When Due	Amount

What amount, if any is past due? . . . . . .$_____

*List separately each item amounting to 10 percent or more of the total and combine the remainder.

6. Deposits with bids or otherwise as guarantees $_____

Deposit with Name & Address	For What	When Recoverable	Amount

7. Interest accrued on loans, securities, etc. $_____

On What Accrued	To be Paid When	Amount

8. Real Estate (a) Used for business purposes $_____
Book Value (b) Not used for business purposes $_____

Description of Property	IMPROVEMENTS		Total Book Value
	Nature of Improvements	Book Value	
1.			
2.			
3.			
4.			
5.			
6.			
7.			

Location	Held in Whose Name	Assessed Value	Amount of Encumbrances
1.			
2.			
3.			
4.			
5.			
6.			
7.			

9. Stocks - Bonds (a) Listed - Present market value $_____
(b) Unlisted - Present Value $_____

Description	Issuing Company	Last Int. or Dividend Paid Date %	Par Value	Present Market Value	Quantity	Amount
1.						
2.						
3.						
4.						
5.						
6.						
7.						

Who has Possession	If any are Pledged or in Escrow, state for whom and reason	Amount Pledged or in Escrow
1.		
2.		
3.		
4.		
5.		
6.		
7.		

10. Materials in stock and not included in Item 4 Assets:
(a) For use on uncompleted contracts (Present Value) $_____
(b) Other Materials (Present Value) . . . . . $_____

Description of Material	Quantity	For Uncompleted Contracts	Other Materials

11. *Equipment at book value . . . . . $_____

Quan-tity	Description & Capacity of Item	Age of Items	Purchase Price	Depreciation Charge Off	Book Value

Are there any liens against the above_____

If so, state total amount . . . . . $_____

12. Furniture & Fixtures at Book Value . . . . . $_____

13. Other Assets . . . . . $_____

Description	Amount

* If two or more items are lumped together above, give the sum of their ages.

TOTAL ASSETS $_____

DETAILS RELATIVE TO LIABILITIES

1. Notes Payable
   - (a) To Banks, regular $_____
   - (b) To Banks, for certified checks $_____
   - (c) To others for equipment obligations $_____
   - (d) To others exclusive of equipment obligations $_____

To Whom	Name & Address	What Security	When Due	Amount

2. Accounts Payable
   - (a) Not past due . . . . . $_____
   - (b) Past due . . . . . $_____

To Whom	Name & Address	For What	Date Payable	Amount

3. Real Estate Encumbrances (See Item 8, Assets) $_____

4. Other Liabilities . . . . . $_____

Description	Amount

5. Reserves . . . . . $_____

Interest	Insurance	Bldg. & Fixt.	Plant Depr.	Taxes	Bad Debts	
$	$	$	$	$	$	$

6. CAPITAL STOCK PAID UP ((a) Common $_____
((b) Preferred $_____

7. SURPLUS . . . . . $_____

TOTAL LIABILITIES $_____

If a corporation answer this:

Amount for which incorporated $ _____

Capital paid in cash _____ $ _____

When incorporated _____

In what State _____

Names and titles of all persons having authority to execute and receipt estimate vouchers and to conduct other business for the corporation, including its officers, the signatures of whom are legally binding.

_____

_____

_____

_____

_____

Do you have necessary "Certificate of Authority" to transact corporate business in this state, under the terms of Chapter 215, Acts of 1929 and Acts amendatory thereto? _____

_____

If a co-partnership answer this:

Date of organization _____

State whether co-partnership is general, limited or association, _____

_____

Give the names, address and proportional interests of all parties:

Name	Address	Share
		$
		$
		$
		$
		$

The name of the partnership firm under which the above partners are operating is:

_____

Give names and titles of all persons having authority to execute and receipt estimate vouchers and to conduct other business for the partnership, the signatures of whom are legally binding.

_____

_____

_____

The undersigned hereby declares: That the foregoing is a true statement of the financial condition of the individual, co-partnership or corporation herein first named, as of the date herein first given; that this statement is for the express purpose of inducing the party to whom it is submitted to award the submittor a contract; and that any depository, vendor or other agency herein named is hereby authorized to supply such party with any information necessary to verify this statement.

NOTE: A co-partnership must give firm name and signatures of all partners. A corporation must give full corporate name, signature of official and affix corporate seal.

_____

_____

_____

_____

_____

AFFIDAVIT FOR INDIVIDUAL

STATE OF _____)
) SS:
COUNTY OF _____)

_____ being duly sworn, deposes and says that the foregoing financial statement, taken from his books, is a true and accurate statement of his financial condition as of the date thereof and that the answers to the foregoing interrogatories are true.

_____
(Applicant must sign here)

Subscribed and sworn to before me
this _____ day of _____, 19___.

_____
Notary Public

AFFIDAVIT FOR CO-PARTNERSHIP

STATE OF _____)
) SS
COUNTY OF _____)

_____ being duly sworn,
deposes and says that he is a member of the firm of:

_____
that he is familiar with the books of said firm showing its financial condition; that the foregoing financial statement, taken from the books of the said firm, is a true and accurate statement of the financial condition of the said firm as of the date thereof and that the answers to the foregoing interrogations are true.

_____
(Member of firm must sign here)

Subscribed and sworn to before me
this _____ day of _____, 19___.

_____
Notary Public

AFFIDAVIT FOR CORPORATION

STATE OF _____)
) SS
COUNTY OF _____)

_____ being duly sworn,
deposes and says that he is

_____
of the _____
the corporation described in and which executed the foregoing statement; that he is familiar with the books of the said corporation showing its financial condition; that the foregoing financial statement, taken from the books of the said corporation, is a true and accurate statement of the financial condition of said corporation as of the date thereof and that the answers to the foregoing interrogatories are true.

_____
(Officer must sign here)

Subscribed and sworn to before me
this _____ day of _____, 19___.

_____
Notary Public

CERTIFICATE IN LIEU OF FINANCIAL STATEMENT

I, _____, the _____
Name

_____ of _____
Position Company

hereby certify:

1. That the Financial Statement of said Company, dated the ____ day of _____, 197 ___, now on file in the office of the Board of Public Works of the City of Fort Wayne, Indiana, which Financial Statement is be referenced incorporated herein and made a part hereof, is a true and correct statement and accurately reflects the financial condition of said Company as of the date hereof:

2. That I am familiar with the books of said Company showing its financial condition and am authorized to make this certificate on its behalf.

DATED:_____

_____
Signature

SUBSCRIBED AND SWORN to before me, a Notary Public, in and for said County and State, this ____ day of _____, 197___.

_____
Notary Public

My Commission Expires:

_____

CONTRACTOR TO COMPLETE THE FOLLOWING CERTIFICATE IF EQUAL EMPLOYMENT STATEMENT AND AFFIRMATIVE ACTION PROGRAM HAVE BEEN PREVIOUSLY FILED WITH THE CITY OF FORT WAYNE. IF CONTRACTOR DOES NOT HAVE SUCH STATEMENTS ON FILE, THEY MUST BE FILED PRIOR TO SUBMISSION OF BIDS.

CERTIFICATE IN LIEU OF EQUAL EMPLOYMENT STATEMENT AND AFFIRMATIVE ACTION PROGRAM

I _____, the _____, of _____
(name) (position) (company)

hereby certify:

(1) That the Equal Employment Statement and the Affirmative Action Program of said company, dated the _____ day of _____, 19_____, is now on file with the Equal Employment Opportunity Office of the City of Fort Wayne, Indiana.

(2) That the Equal Employment Statement and the Affirmative Action Program has been approved by the Equal Employment Opportunity Officer of the City of Fort Wayne, Indiana.

(3) That said company is/is not Signatory to the Fort Wayne and Area Plan either by direct agreement to the Plan or by virtue of a contract agreement with a Union that is signatory to the Plan.

DATED: _____

State of Indiana
County of Allen

_____
Signature

_____
Notary

My Commission Expires:

_____

INSTRUCTIONS TO BIDDERS
EQUAL EMPLOYMENT OPPORTUNITY - AFFIRMATIVE ACTION PROGRAM

IMPLEMENTATION OF EQUAL EMPLOYMENT OPPORTUNITY POLICY. The equal employment opportunity police is implemented through an Affirmative Action Program. The program should be designed to hire qualified minority persons in all of the various job categories when needed, and the firm should establish specific goals to increase the number of minorities in the various job categories through hiring or promotion.

The City of Fort Wayne has approved some goals and timetables to serve as guidelines for firms with whom it does business. All firms doing business with the City should employ a representative number of minorities in all job classifications within a four-year period, using the percentage of the non-white population as a goal. These firms should also establish specific goals and timetables for achieving their goals. Such goals and timetables shall be a part of a firm's Affirmative Action Program and shall be maintained on a year-by-year basis. If a firm cannot meet the established goals and timetables, it will be evaluated on its "good faith" effort; that is - whether the Affirmative Action Program is being followed in fact and whether every attempt is being made to attain the goals according to the timetables.

Another factor supporting the "good Faith" effort is whether the firm has conducted an analysis of all major job categories at the facility to determine if minorities are currently being underutilized in any one or more job catefories. ("Underutilization means having fewer minorities in a particular job category than would reasonably be expected by their availability). Consideration of "good faith" effort shall also be given to the following factors:

1. The minority population of the labor area

2. The size of the minority unemployment force in the labor area.

3. The percentage of the minority work force as compared with the total work force in the immediate labor area.

4. The general availability of minorities having requisite skills in the immediate labor area.

5. The availability of minorities having requisite skills in an area in which the facility can reasonably recruit.

6. The availability of promotable minority employees within facility's organization.

7. The anticipated expansion, contraction and turnover of and in the work force.

8. The existence of training institutions capable of training minorities in the requisite skills.

9. The degree of training which the firm is reasonably able to undertake as a means of making all job classifications available to minorities.

10. The use of recruitment sources where minorities can be secured.

Every effort should be directed to increase materially the number of minorities at all levels and in all segments of the work force of the company with particular emphasis on segments of the work force where few, if any, minority persons are employed. Special attention should be given to the categories of officials and managers, professionals, technicians, sales workers, office and clerical, and skilled craftsmen.

CITY OF FORT WAYNE

AFFIRMATIVE ACTION PROGRAM

Name of Company _____

Address _____

City _____ Telephone _____

"This company, its subsidiaries, and its divisions shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, national origin, ancestry or place of birth, and shall take such affirmative action as necessary to insure that applicants are employed and employees are treated equally during employment without regard to race, color, religion, sex, national origin, ancestry or place of birth."

I. Does your firm have a written Affirmative Action Program?

Yes_____ No_____

If so, attach copy. If not, do you accept the following program in meeting the requirements of the City of Fort Wayne?

Yes_____ No_____

II. Will your firm make every effort to increase imployment of minorities at all levels of its workforce with particular emphasis to categories where few, if any, minority people are employed?_____

III. Current number of employees_____

Number of employees as of January 1976_____

April 1976 _____

July 1976 _____

October 1976 _____

IV. WORKFORCE ANALYSIS

Job Classification	Wage Rate or Salary Range	Total	B	H	AI or AN	API	F

B= Black (not of Hispanic origin)
H= Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture of origin)
AI,AN= American Indian or Alaskan Native
API= Asian or Pacific Islanders
F= Females

V. If total minority employment is less than 11% give reasons why

_____

_____

_____

VI. Has your firm actively tried to recruit minorities in every job catagory?

Yes _____ No _____

If yes, in what manner? _____

_____

_____

_____

VII. List Minority recruitment sources.

_____

_____

_____

VIII. Does your company anticipate an increase in employment this year?

Yes_____ No_____

Approximately how many?_____

IX. What specific goals can you achieve for the employment of minorities during 1977?

A. Officials and Managers_____%

B. Professionals_____%

C. Technicians_____%

D. Sales Workers_____%

E. Office and Clerical Workers_____%

F. Skilled Craftsmen_____%

G. Other_____%

PLEASE KEEP IN MIND THAT FAILURE TO COMPLETE ALL SECTIONS OF THIS DOCUMENT WILL RESULT IN YOUR PROGRAM BEING REGECTED.

X. Identify by title and name the highest official within the facility who has overall responsibility for the implementation of the equal employment opportunity policy and affirmative action program.

_____ _____

Date_____Signature_____

WRITTEN STATEMENT OF COMPANY POLICY

It is the policy of _____ that
(Name of Company)
equal employment opportunity be afforded to all qualified persons without regard to race, religion, color, sex or national origin.

In support of this policy_____will not
(Name of Company)
discriminate against any employee or applicant for employment because of race, religion, sex or national origin.

The_____will take
(Name of Company)
affirmative action to insure that applicants are employed and that employees are treated during employment without regard to their race, religion, color, sex or national origin. Such action will include but not be limited to:

RECRUITMENT, ADVERTISING OR SOLICITATION FOR EMPLOYMENT
HIRING, PLACEMENT, UPGRADING, TRANSFER OR DEMOTION SELECTION
FOR TRAINING INCLUDING APPRENTICESHIP RATES OF PAY OR OTHER
FORMS OF COMPENSATION LAYOFFS OR TERMINATION

_____
(Name of Company)

_____
(Signature of Company Official)

_____
(Date)

THE AGREEMENT

THIS AGREEMENT, made between _____

_____,

hereinafter called the "Contractor", and _____

_____,

hereinafter called the "Owner".

WITNESSETH, that the Contractor and the Owner, for the considerations hereinafter named, agree as follows:

ARTICLE 1 - THE WORK. It is agreed that the Contractor shall furnish all the materials and equipment and perform all of the work shown on the drawings and described in the specifications entitled:

prepared by McNamee, Porter and Seeley, acting as, and in these Contract Documents entitled, the Engineer; and shall do everything required by the Contract Documents; the Contract Documents being hereby defined to include the Advertisement, Instructions to Bidders, Proposal, Agreement, Bonds, Drawings, Specifications and any supplements thereto agreed to by both parties.

It is further agreed that the work shall be done using the following named materials and types of construction offered either in the base proposal or alternate thereto.

ARTICLE 2 - ALTERATIONS. It is agreed that the Contractor shall make alterations to the work under this contract as the Owner may especially order in writing. Such alterations shall be paid for at prices mutually agreed upon at the time by the Owner and the Contractor or on the cost plus basis set forth below.

In the case of additions only where a price cannot be agreed upon in advance, then the Owner will pay, and the Contractor shall accept, as full compensation for such work, an amount equal to the actual and necessary net cost in money to the Contractor for labor, materials and equipment (in addition to that available at the site) actually used therein or expended thereon, plus 30% of the total labor cost, plus 10% of the actual net material cost, plus sales tax, plus 5% of the actual net cost of any subcontract work for superintendence, power, the use of tools and plant available at the site, federal and state taxes, workmen's compensation insurance, public liability insurance, bond premium and all overhead and incidental expenses.

During the progress of any extra work which is to be paid for on the basis of net cost plus stipulated percentage, the Contractor shall furnish to the Owner, at the end of each day, suitable time slips showing the name of and the number of hours worked by each workman employed thereon, the nature of the work performed by such workman, and his rate of pay together with suitable and adequate memoranda of the materials used therein showing the character and amount of each such material, the sources from which it was purchased, and the price paid or to be paid therefor.

The Owner, at its discretion, may furnish to the Contractor any materials or supplies or transportation required for extra work. The Contractor shall not be entitled to any allowance for percentage on account of materials or supplies or transportation so furnished.

It is agreed that all work that may be ordered by the Owner and performed under the provisions of this article shall be done by the Contractor in an effective and workmanlike manner and shall be subject to the same restrictions and liabilities as those which apply to the general work of this contract; and the Contractor will be responsible for the maintenance and protection of such work until the time of the final acceptance of the entire job by the Owner.

It is further agreed that no claim against the Owner on account of alterations shall be valid unless such work has been previously ordered in writing, and unless such claim has been presented for payment as soon as practicable after the completion of such work and before the making up of the final estimate.

ARTICLE 3 - TIME - It is agreed that the Contractor shall begin work under this contract within ten days after the mailing to the Contractor of the written notice to proceed and that he shall prosecute it in such manner as will bring the entire work to completion within 200 calendar days after the date of beginning, except as such time limits may be advanced in accordance with the provisions of Article 4 herein. The time of beginning, rate of progress, and date of completion are considered essential elements of the contract.

ARTICLE 4 - EXTENSION OF TIME - It is agreed that, if the Contractor shall be unavoidably delayed in beginning or fulfilling this contract by reason of excessive storms or floods, or by acts of Providence, or by general strikes, or by court injunction, or by stopping of the work by the Owner because of any emergency or public necessity; or by the actions of other contractors engaged in this program; or by reason of alterations ordered by the Owner, the Contractor shall have no valid claim for damages on account of any cause or delay, but he shall in such case be entitled to such an extension or advancement of the time periods specified in Article 3 herein as the Engineer shall adjudge to be just and reasonable; provided, however, that formal claims for such extension shall be made in writing by the Contractor within a week after the date upon which such alleged cause or delay shall have occurred.

ARTICLE 5 - LIQUIDATED DAMAGES - It is expressly convenanted and agreed that time is and shall be considered of the essence of the contract. In the event that the Contractor shall fail in due

performance of the entire work to be performed under this contract, or to perform any certain portions thereof for which definite stipulations have been agreed to, by and at the times herein mentioned and referred to in Article 3, or within some other certain date subsequent to this to which the time limit for the completion of the work may have been advanced under the provisions of Article 4, the Contractor shall pay unto the Owner, as and for liquidated damages and not as a penalty, the sum of One Hundred Dollars ($100) for each and every calendar day that the Contractor shall be in default. Said sum of One Hundred Dollars ($100) per day, in view of the difficulty of estimating such damages with exactness, is hereby expressly fixed and agreed upon as the damages which will be suffered by the Owner for reason of such defaults. It is also understood and agreed that the liquidated damages hereinbefore mentioned are in lieu of the actual damages arising from such breaches of the contract, which said sums the Owner shall have the right to deduct from any monies in its hands, otherwise due, or to become due, to the Contractor, or to sue for and recover compensation or damages for non-performance of this contract at the time stipulated herein and provided for.

ARTICLE 6 - ASSIGNMENT OF CONTRACT - It is agreed that the Contractor shall not assign or transfer this contract or sublet any part of the work embraced in it, except with the written consent of the Owner to do so.

It is further agreed that all parts of the work which may be performed by a subcontractor shall be done in conformity with and be subject to all the provisions of the Contract Documents exactly as if performed by the Contractor and his immediate employees and workmen. No subletting of the work shall in any way diminish or weaken the responsibility of the Contractor for all parts of the work or lessen his obligations and liabilities under this Agreement.

It is likewise agreed that the Contractor shall not assign, either legally or equitably, any of the moneys payable to him under this Agreement, or his claim thereto, except with the written consent of the Owner.

ARTICLE 7 - OWNER'S RIGHT TO COMPLETE - It is agreed that, if at any time the Contractor shall be adjudged bankrupt, or if he should make a general assignment for the benefit of his creditors, or if a receiver should be appointed on account of his insolvency, or if he should persistently or repeatedly fail to supply enough properly skilled workmen or sufficient suitable materials for the work, or if he should habitually fail to make prompt payment to subcontractors or to pay promptly for materials and labor, or if he should persistently disregard laws or ordinances or the directions of the Engineer, or if he should wilfully and repeatedly violate any of the substantial provisions of this Agreement; then in such case the Owner upon receipt of a certificate from the Engineer stating that sufficient cause exists to justify such action and stating the nature of said cause and after giving the Contractor and his sureties written notice thereof, may order him to discontinue all work under this contract, or any part thereof. Thereupon the Contractor shall at once discontinue such work or such part thereof, and shall cease to have any right to the possession of the ground. The Owner shall have the right to finish the work, or such part thereof, by contract or otherwise as he may elect, and for that purpose to take possession and make use of such materials, tools, building appliances and equipment as may be found upon the work, and to charge the cost and expense of such completion to the Contractor. The Contractor shall not be entitled to receive any further payment until the work is finished. If the unpaid balance of the contract price shall exceed the expense of finishing the work, including compensation for additional managerial and administrative services, the amount of such excess shall be paid to the Contractor, and if such expense shall exceed such unpaid balance, the Contractor shall pay to the Owner the amount of such excess.

It is expressly stipulated and agreed that, from and after the date of the order to discontinue work, and until such work shall have been finally completed by the Owner, neither the Contractor nor any of his agents or employees shall remove, or make any effort, directly or indirectly, to remove any of the above mentioned materials, tools, building appliances or equipment from the points at which they were located on the date of said order, except upon the written consent of the Owner to do so.

It is further understood and agreed that the foregoing provisions of this article are without prejudice to any other right or remedy which the Owner may have under this Agreement.

ARTICLE 8 - GENERAL STIPULATIONS - It is agreed that the Contractor shall comply with the following general stipulations:

Permits and Regulations. The Contractor shall secure and bear the cost of any building permits, special permits or licenses of a temporary nature necessary for the prosecution of the work. In particular, he shall secure and bear the cost of shutting off and turning on public services of very nature which may be required by his operations. Where such discontinuance of services affects consumers, due and sufficient notice shall be served upon those so affected.

Workmen's Compensation Insurance. The Contractor shall procure and shall maintain during the life of this contract, Employer's Liability and Workmen's Compensation Insurance for all of his employees to be engaged in work on the project under this contract; and in case any such work is sublet, the Contractor shall require the subcontractor similarly to provide Employer's Liability and Workmen's Compensation Insurance for all of the latter's employees to be engaged in such work.

In case any class of employees engaged in hazardous work under this contract is not protected under the Workmen's Compensation statute, the Contractor shall provide and shall cause each subcontractor to provide adequate insurance coverage for the protection of the employees not so covered.

Contractor's Public Liability Insurance. The Contractor shall procure and shall maintain during the life of this contract Contractor's Bodily Injury Insurance in an amount not less than $200,000 for injuries, including accidental death, to each person, in an amount not less than $500,000 on account of each occurrence; and Contractor's Property Damage Insurance in an amount not less than $100,000 each occurrence, and $200,000 aggregate including Completed Operations and Contractual Liability Coverages.

This Public Liability Insurance shall include coverage for Explosion, Collapse and Underground Hazards.

Subcontractor's Public Liability Insurance. The Contractor shall require each of his subcontractor's to procure and to maintain during the life of his subcontract, Bodily Injury Insurance in an amount not less than $200,000 for injuries, including accidental death, to each person, and in an amount not less than $500,000 on account of each occurrence; and the Contractor's Property Damage Insurance in an amount not less than $100,000 each occurrence and $200,000 aggregate.

The Contractor shall require each of his subcontractors to procure and maintain during the life of this contract Contractor's Protective Public Liability Insurance in an amount not less than $200,000 for injuries, including accidental death, to each person, and in an amount not less than $500,000 on account of each occurrence; and property damage in an amount not less than $100,000 each occurrence, and $200,000 aggregate.

This Public Liability Insurance shall include coverage for Explosion, Collapse and Underground Hazards.

Contractor's Automobile Bodily Injury and Property Damage Insurance.

1. The Contractor shall procure and shall maintain during the life of this contract Automobile Bodily Injury Insurance in an amount not less than $200,000 for injuries, including accidental death, to each person, and in an amount not less than $500,000 for each occurrence; and property damage in an amount not less than $50,000 for each occurrence.

2. The Contractor shall procure and shall maintain during the life of this contract Hired and Non-Ownership Automobile Bodily Injury and Property Damage Insurance in an amount not less than $200,000 for injuries, including accidental death, to each person; and in an amount not less than $500,000 for each occurrence; and property damage in an amount not less than $50,000 for each occurrence

Owner's Protective Public Liability Insurance. The Contractor shall procure and maintain during the life of this contract Owner's Protective Public Liability Insurance in the name of the Owner and Engineer in an amount not less than $200,000 for injuries, including accidental death, to each person, and in an amount not less than $500,000 on account of each occurrence; and property damage in an amount not less than $100,000 each occurrence and $200,000 aggregate.

Fire Insurance. The Contractor shall insure for the life of the Contract against loss or damage by fire at the site and against loss or damage covered by the standard extended coverage insurance endorsement. The insurance policy shall be held jointly in the names of the Owner and the Contractor. The amount of the policy may vary with the extent of the work completed, but shall at all times be at least equal to the amount paid on account of work and materials plus the value of work or materials furnished or delivered by the Contractor but not paid for by the Owner.

Additional Insurance. Where the work under the contract crosses or is adjacent to a railroad, such insurance as is required by the railroad shall be furnished in the name of the railroad or railroads.

Indemnification Clause. The Contractor shall hold harmless from and indemnify the Owner and Engineer against all claims, suits, actions, costs, counsel fees, expenses, damages, judgments or decrees, by reason of any person or persons or property being damaged or injured by the acts or omissions of the Contractor or any of his subcontractors, or any person employed under said Contractor, or under any of his subcontractors, during the progress of this contract.

Proof of Carriage of Insurance. The Contractor shall provide the Owner, at the time contracts are returned by him for execution, certificates and policies listed below. A guarantee that ten (10) days' notice to the Owner prior to cancellation of or change in any such insurance shall be endorsed on each policy and certificate of insurance.

1. . Ten (10) copies of Certificate of Coverage for Contractor's Workmen's Compensation Insurance.

2. Ten (10) copies of Certificate of Coverage for Contractor's Public Liability Insurance.

3. Ten (10) copies of Certificate of Coverage for Contractor's Automobile Bodily Injury and Property Damage Insurance covering owned, hired, and non-owned vehicles.

4. Ten (10) copies of policy for Owner's Protective Public Liability Insurance.

5. Ten (10) copies of Certificate of Coverage for Fire Insurance.

The Contractor shall not commence work under this contract until he has obtained all insurance required and such insurance has been approved by the Owner, nor shall the Contractor allow any subcontractor to commence work on his subcontract until all similar insurance required of the subcontractor has been so obtained and approved.

Labor Laws and Ordinances. The Contractor shall obey and abide by all the laws of the State of Indiana, relating to the employment of labor on public work and all the laws and requirements of the Owner regulating or applying to public improvements.

Local Sources for Labor and Materials. It is understood and agreed by and between the parties of this contract that all labor employed on the work shall be obtained from local residents insofar as this is available. It is further agreed that all materials and supplies used in the construction work shall be purchased through dealers in the area insofar as practicable.

Patents and Patent Rights. The Contractor shall protect and save the Owner harmless against all claims or actions brought against the Owner by reason of any actual or alleged infringement upon patent rights in any article, material, process, machine or appliance used by him in this work.

ARTICLE 9 - ARBITRATION. All matters in dispute arising from this contract shall be promptly submitted to arbitration upon demand by either party to the dispute. The contractor shall not delay the work because arbitration proceedings are pending, unless he shall have written permission from the Owner to do so and such delay shall not extend beyond the time when the arbitrators shall have an apportunity to determine whether the work shall continue or be suspended pending decision by the arbitrators of such a dispute. Any demand for arbitration shall be in writing and shall be delivered to the Engineer and the adverse party either by personal delivery or by registered mail addressed to the last known address of each within 10 days of receipt of the Engineers decision and in no event after final payment has been made and accepted. Should the Engineer fail within a reasonable period to make a decision regarding claim of the Owner or contractor, a demand for arbitration may be made as if the Engineers decision had been rendered against the party demanding arbitration.

No one shall be qualified to act as an arbitrator who has directly or indirectly any financial interest in the contract or has any business or family relationship with the Owner, contractor or the Engineer. Each arbitrator selected shall be qualified by experience and knowledge of the work involved in the matter to be submitted to arbitration.

Each of the parties hereto shall pay one-half of the expense of such arbitration.

Arbitration shall be in accordance with the procedure and standards of the American Arbitration Association.

ARTICLE 10 - PAYMENT. And it is agreed that, in consideration of the faithful and entire performance by the Contractor of his obligations under this contract, the Owner shall pay to him, at the times and in the manner hereinafter stipulated, the following named Contract Sum: _____

_____

_____ Dollars ($ _____).

Such contract sum shall be modified by such sums for alterations as may have been determined under the provisions of Article 2 herein and diminished by such sums as the Owner may lawfully deduct and retain as liquidated damages under the provisions of Article 5.

At about the close of each month during which satisfactory progress has been made toward the final completion of the work, the Engineer will make an estimate of the amount and value of the work which has been done under this contract during that month, or since the date of the last preceding estimate. Such estimate shall not be required to be made by strict measurement or with exactness, but may be made either wholly or in part by appraisement or estimation or by a consideration of accounts for labor and materials, and it shall be sufficient if it is approximate only. Any error or inaccuracy which may occur in any such progress estimate may be allowed for or corrected in any subsequent estimate.

The progress estimates and payments thus provided for will include all alterations which may be done under the provisions of Article 2 of this Agreement on the same basis as other work is included. All such work is regarded as essentially a part of the contract and not merely an addition to it.

It is agreed that, before the Contractor shall demand partial or final estimates or payments, he shall furnish to the Owner, if and when requested to do so, supported, if requested, by sworn statements, satisfactory evidence that all persons who have supplied labor, materials, or equipment for the work embraced under this contract have been fully paid for the same; and that, in case such evidence be not furnished as aforesaid, such sums as the Owner may deem necessary to meet the lawful claims of such persons may be retained by the Owner from any moneys that may be due or become due to the Contractor under this Agreement until such liabilities shall be fully discharged and the evidence thereof be furnished to the Owner.

Generally no allowance will be made in any progress estimate for materials furnished and delivered on the ground until such materials shall have been permanently incorporated in the work. However, in the case of heavy equipment and other indestructible items, properly stored and protected, the Engineer may make allowance in the estimate of the invoice price of such items.

As soon as practicable after such estimate is made up and certified and upon its approval by the Owner, the Owner shall pay to the Contractor, on account, a sum equal to the estimate less a retainage, except that the Owner may deduct and retain out of any such partial payment a sum for unsatisfactory work or sufficient to meet any undischarged obligations of the Contractor for labor, materials or equipment furnished for the work. Periodic payment retainage amounts shall be based on the following schedule:

(a) Retention of up to 10% of payments claimed until construction is 50% complete;

(b) After construction is 50% complete, reduction of the total retainage to 5% of payments claimed, provided that the Contractor is making satisfactory progress and there is no specific cause for greater withholding;

(c) When the project is substantially complete (operational or beneficial occupancy), the retained amount shall be further reduced below 5% to only that amount necessary to assure completion of the contract work;

(d) A cash bond or irrevocable letter of credit may be accepted in lieu of all or part of the cash retainage under (b) or (c), above.

No progress estimate made or certified by the Engineer and no partial payment to the Contractor by the Owner shall be deemed or construed as an acceptance of any part of the work under this contract.

As soon as practicable after the satisfactory completion of all work covered by this Agreement, the Engineer will make a final inspection of the work as a whole and will make up a final estimate of the total amount due the Contractor under the terms of the Agreement. Upon the acceptance of the completed work, the Owner will pay to the Contractor the entire amount of such final estimate, less the sums previously paid, and less such sums as the Owner may deem to be necessary to meet the undischarged obligations of the Contractor for labor, materials or equipment furnished for the work. The Contractor shall file with the Owner a sworn statement that all claims for amounts due for labor, materials, and equipment furnished for this work have been paid in full, or he shall so file in lieu thereof, a sworn statement showing in detail the nature and amount of all unpaid claims for said labor, materials and equipment.

Hagerman Construction Corporation

GENERAL CONTRACTORS

219-424-1470

Office: 403 Strauss Building · Phone [redacted]

P.O.Box 590

FORT WAYNE, INDIANA 46801

November 8, 1977

Board of Public Works of
City of Fort Wayne
City-County Building
One Main Street
Fort Wayne, Indiana 46802

Re: Water Works Improvements
Wash Water Retention Basin
Contract No. 77-W-1

Gentlemen:

Please be advised that we wish to retain the option of doing the piling work on this project by our own forces, by another subcontractor, or by Ruckman. This is due to the recent demise of Mr. Phil Ruckman, the President of Ruckman-Hansen, Inc. and we are therefore attaching this option to Page 1, AI-120472 of the agreement.

Very truly yours,

HAGERMAN CONSTRUCTION CORPORATION

By Mark F. Hagerman

Mark F. Hagerman, Vice President

MFH:bis

cc: McNamee, Porter & Seeley

STATE OF INDIANA:
SS:
COUNTY OF ALLEN:

BEFORE ME, a Notary Public, in and for said State, came T.F. HAGERMAN as principal, and GERALD A. DAHLE of the YASTE, ZENT & RYE AGENCY Attorney in Fact, for said UNITED STATES FIDELITY & GUARANTY COMPANY as surety, with both of whom I am personally acquainted, and acknowledged that they subscribed their signatures to the above and foregoing bond.

SUBSCRIBED TO, before me, a Notary Public, this 8th day of NOVEMBER, 1977.

William L. Kern
Notary Public

My Commission Expires:
11-18-78

Fort Wayne, IN 77-W-1

CERTIFIED COPY

GENERAL POWER OF ATTORNEY

No. 87671

Know all Men by these Presents:

That UNITED STATES FIDELITY AND GUARANTY COMPANY, a corporation organized and existing under the laws of the State of Maryland, and having its principal office at the City of Baltimore, in the State of Maryland, does hereby constitute and appoint C. H. Yaste, Arthur C. Frericks, Donald T. Belbutowski, Gerald A. Dahle and Leonard Shirley

of the City of Fort Wayne, State of Indiana, its true and lawful attorneys in and for the State of Indiana

for the following purposes, to wit:

To sign its name as surety to, and to execute, seal and acknowledge any and all bonds, and to respectively do and perform any and all acts and things set forth in the resolution of the Board of Directors of the said UNITED STATES FIDELITY AND GUARANTY COMPANY, a certified copy of which is hereto annexed and made a part of this Power of Attorney; and the said UNITED STATES FIDELITY AND GUARANTY COMPANY, through us, its Board of Directors, hereby ratifies and confirms all and whatsoever ~~XXXX~~ anyone of the said C. H. Yaste and the said Arthur C. Frericks and the said Donald T. Belbutowski and the said Gerald A. Dahle and the said Leonard Shirley

may lawfully do in the premises by virtue of these presents.

In Witness Whereof, the said UNITED STATES FIDELITY AND GUARANTY COMPANY has caused this instrument to be sealed with its corporate seal, duly attested by the signatures of its Vice-President and Assistant Secretary, this 28th day of March, A. D. 19 77

UNITED STATES FIDELITY AND GUARANTY COMPANY.

(Signed) By James A. Mappus
Vice-President.

(SEAL) (Signed) John C. Vaeth, Jr.
Assistant Secretary.

STATE OF MARYLAND, BALTIMORE CITY, } ss:

On this 28th day of March, A. D. 1977, before me personally came James A. Mappus, Vice-President of the UNITED STATES FIDELITY AND GUARANTY COMPANY and John C. Vaeth, Jr., Assistant Secretary of said Company, with both of whom I am personally acquainted, who being by me severally duly sworn, said that they resided in the City of Baltimore, Maryland; that they, the said James A. Mappus and John C. Vaeth, Jr. were respectively the Vice-President and the Assistant Secretary of the said UNITED STATES FIDELITY AND GUARANTY COMPANY, the corporation described in and which executed the foregoing Power of Attorney; that they each knew the seal of said corporation; that the seal affixed to said Power of Attorney was such corporate seal, that it was so fixed by order of the Board of Directors of said corporation, and that they signed their names thereto by like order as Vice-President and Assistant Secretary, respectively, of the Company.

My commission expires the first day in July, A. D. 19...78..

(SEAL) (Signed) Margaret M. Hurst
Notary Public.

STATE OF MARYLAND BALTIMORE CITY, } Sct.

I, Robert H. Bouse, Clerk of the Superior Court of Baltimore City, which Court is a Court of Record, and has a seal, do hereby certify that Margaret M. Hurst, Esquire, before whom the annexed affidavits were made, and who has thereto subscribed his name, was at the time of so doing a Notary Public of the State of Maryland, in and for the City of Baltimore, duly commissioned and sworn and authorized by law to administer oaths and take acknowledgments, or proof of deeds to be recorded therein. I further certify that I am acquainted with the handwriting of the said Notary, and verily believe the signature to be his genuine signature.

In Testimony Whereof, I hereto set my hand and affix the seal of the Superior Court of Baltimore City, the court being a Court of Record, this 28th day of March, A. D. 1977

(SEAL) (Signed) Robert H. Bouse
Clerk of the Superior Court of Baltimore City.

COPY OF RESOLUTION

That Whereas, it is necessary for the effectual transaction of business that this Company appoint agents and attorneys with power and authority to act for it and in its name in States other than Maryland, and in the Territories of the United States and in the Provinces of the Dominion of Canada and in the Colony of Newfoundland.

Therefore, be it Resolved, that this Company do, and it hereby does, authorize and empower its President or either of its Vice-Presidents in conjunction with its Secretary or one of its Assistant Secretaries, under its corporate seal, to appoint any person or persons as attorney or attorneys-in-fact, or agent or agents of said Company, in its name and as its act, to execute and deliver any and all contracts guaranteeing the fidelity of persons holding positions of public or private trust, guaranteeing the performances of contracts other than insurance policies and executing or guaranteeing bonds and undertakings, required or permitted in all actions or proceedings, or by law allowed, and

Also, in its name and as its attorney or attorneys-in-fact, or agent or agents to execute and guarantee the conditions of any and all bonds, recognizances, obligations, stipulations, undertakings or anything in the nature of either of the same, which are or may by law, municipal or otherwise, or by any Statute of the United States or of any State or Territory of the United States or of the Provinces of the Dominion of Canada or of the Colony of Newfoundland, or by the rules, regulations, orders, customs, practice or discretion of any board, body, organization, office or officer, local, municipal or otherwise, be allowed, required or permitted to be executed, made, taken, given, tendered, accepted, filed or recorded for the security or protection of, by or for any person or persons, corporation, body, office, interest, municipality or other association or organization whatsoever, in any and all capacities whatsoever, conditioned for the doing or not doing of anything or any conditions which may be provided for in any such bond, recognizance, obligation, stipulation, or undertaking, or anything in the nature of either of the same.

I, Richard Calder, an Assistant Secretary of the UNITED STATES FIDELITY AND GUARANTY COMPANY, do hereby certify that the foregoing is a full, true and correct copy of the original power of attorney given by said Company to C. H. Yaste, Arthur C. Frericks, Donald T. Belbutowski, Gerald A. Dahle and Leonard Shirley

of Fort Wayne, Indiana, authorizing and empowering them to sign bonds as therein set forth, which power of attorney has never been revoked and is still in full force and effect.

And I do further certify that said Power of Attorney was given in pursuance of a resolution adopted at a regular meeting of the Board of Directors of said Company, duly called and held at the office of the Company in the City of Baltimore, on the 11th day of July, 1910, at which meeting a quorum of the Board of Directors was present, and that the foregoing is a true and correct copy of said resolution, and the whole thereof as recorded in the minutes of said meeting.

In Testimony Whereof, I have hereunto set my hand and the seal of the UNITED STATES FIDELITY AND GUARANTY COMPANY on NOVEMBER 8, 1977.
(Date)

Richard Calder
Assistant Secretary.

WHEREAS, no change, modification, omission, or addition in and to the terms or conditions of said contract, plans, specifications, drawings, or profile, or any irregularity or defect in said contract or in the proceedings preliminary to the letting and awarding thereof shall in any way affect or operate to release or discharge said surety and the provisions and conditions of Chapter 258 of the Acts of the General Assembly of Indiana, of 1933, shall be, operate as, and become a part of the terms of this bond and said contract the same as if incorporated herein.

NOW THEREFORE, if the principal shall perform all of the terms and conditions required of it by the consent to cause said water main to become a part of the City water distribution system, and shall for one (1) year after acceptance of said water main by City maintain said water main and shall indemnify the City for all loss that City may sustain by reason of the Principal's failure to comply with any of the terms of the authorization, then this obligation shall be void, otherwise it shall remain in full force and effect.

Hagerman Construction Corporation
(Contractor or Developer)

By _____
(Principal) T. F. Hagerman, President

UNITED STATES FIDELITY AND GUARANTY COMPANY
(Insurance Company)

By _____
Surety GERALD A. DAHLE
ATTORNEY-IN-FACT

Fort Wayne, IN 77-W-1

CITY OF FORT WAYNE, INDIANA

IMPROVEMENT TO FORT WAYNE WATER UTILITY

PERFORMANCE AND GUARANTY BOND

NOW ALL MEN BY THESE PRESENTS, that we Hagerman Construction Corporation (Contractor or Developer) as Principal, and the UNITED STATES FIDELITY AND GUARANTY COMPANY (Insurance Company), a corporation organized under the laws of the State of MARYLAND 1896 (State and Date), and duly authorized to transact business in the State of Indiana, as Surety, are held firmly bound unto the City of Fort Wayne, Indiana, an Indiana Municipal Corporation in the sum of $540,600.00, (value of work) for the payment whereof well and truly to be made, the Principal and the Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by those present. The condition of the foregoing obligation is such that

WHEREAS, the Principal has entered into contract with the City or has applied for authority to construct or cause to be constructed, a water main to become part of the City's water distribution system, which said water main is to be built and constructed according to plans and specifications prepared by or approved by City and known as the Water Works Improvements, Wash Water Retention Basin, Contract 77-W-1 (Name of Project) and,

WHEREAS, the grant of authority by City to so construct such water main provides:

1. That said water main shall be completed according to said plans and specifications, and there shall be filed with the City, within thirty (30) days after completion, a Completion Affidavit.
2. Said Principal is required to agree to make such adjustments, modifications, and repairs as required by the City within thirty (30) days after notice, and,
3. To agree to maintain said water main for a period of one (1) year following written acceptance by the City of said water main, and,

WHEREAS, said Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration, or addition to the terms of the contract or to the work to be performed thereunder, or the specifications accompanying the same, shall in any way affect its obligation on this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the contract, or to the work or to the specifications, and

INSTRUCTIONS FOR EXECUTING AGREEMENT

Contractor be a corporation, the following certificate should be executed.

I, William D. HAGERMAN, certify that I am the ACTING Secretary of the corporation named as Contractor hereinabove; that T.F. HAGERMAN, who signed the foregoing agreement on behalf of the Contractor, was then PRESIDENT of said Corporation; that said agreement was duly signed for and in behalf of said Corporation by authority of its governing body, and is within the scope of its corporate powers.

William D. Hagerman (Corporate Seal)

If the agreement be signed by the secretary of the corporation, the above certificate should be executed by some other officer of the corporation, under the corporate seal. In lieu of the foregoing certificate there may be attached to the agreement copies of so much of the records of the corporation as will show the official character and authority of the officers signing, duly certified by the secretary or assistant secretary under the corporate seal, to be true copies.

The full name and business address of the Contractor should be inserted and the agreement should be signed with his official signature. Please have the name of the signing party or parties typewritten or printed under all signatures to the agreement.

If the Contractor should be operating as a partnership, each partner should sign the agreement. If the agreement be not signed by each partner there should be attached to the agreemetn a duly authenticated power of attorney evidencing the signer's (signers') authority to sign such agreement for and in behalf of the partnership.

If the Contractor be an individual, the trade name (if the Contractor be operating under a trade name) should be indicated in the agreement and the agreement should be signed by such individual. If signed by a person other than the Contractor there should be attached to the agreement a duly authenticated power of attorney evidencing the signer's authority to execute such agreement for and in behalf of the Contractor.

IN WITNESS WHEREOF, the parties hereto have set their hands and seals, in quadruplicate, this 9th day of November, 1977.

CITY OF FORT WAYNE, INDIANA

BY: Robert E. Armstrong
Robert E. Armstrong, Mayor

BOARD OF PUBLIC WORKS

Henry P. Wehrenberg
Henry P. Wehrenberg, Chairman

Ethel H. LaMar
Ethel H. LaMar, Member

Max G. Scott
Max. G. Scott, Member

ATTEST: Ursula Miller
Ursula Miller, Clerk

APPROVED AS TO FORM AND LEGALITY:
Harry Ds Burke
City Attorney
Wacmts

APPROVED BY THE COMMON COUNCIL OF THE CITY OF FORT WAYNE on _____ day of _____, 1977.

Special Ordinance No. _____

CONTRACTOR
Hagerman Construction Corporation

WITNESSES:
Jim O. Hagerman

By: T.F. Hagerman
T.F. Hagerman, President

Sources for Labor and Materials. It is understood and agreed by and between the parties of this t that all labor employed on the work shall be obtained from local residents insofar as this is le. It is further agreed that all materials and supplies used in the construction work shall be sed through dealers in the area insofar as practicable.

s and Patent Rights. The Contractor shall protect and save the Owner harmless against all claims or s brought against the Owner by reason of any actual or alleged infringement upon patent rights in rticle, material, process, machine or appliance used by him in this work.

ICLE 9 - ARBITRATION. All matters in dispute arising from this contract shall be promptly itted to arbitration upon demand by either party to the dispute. The contractor shall not delay the because arbitration proceedings are pending, unless he shall have written permission from the er to do so and such delay shall not extend beyond the time when the arbitrators shall have an rtunity to determine whether the work shall continue or be suspended pending decision by the trators of such a dispute. Any demand for arbitration shall be in writing and shall be delivered to the gineer and the adverse party either by personal delivery or by registered mail addressed to the last wn address of each within 10 days of receipt of the Engineers decision and in no event after final ment has been made and accepted. Should the Engineer fail within a reasonable period to make a sion regarding claim of the Owner or contractor, a demand for arbitration may be made as if the gineers decision had been rendered against the party demanding arbitration.

one shall be qualified to act as an arbitrator who has directly or indirectly any financial interest in the ntract or has any business or family relationship with the Owner, contractor or the Engineer. Each trator selected shall be qualified by experience and knowledge of the work involved in the matter to submitted to arbitration.

ch of the parties hereto shall pay one-half of the expense of such arbitration.

bitration shall be in accordance with the procedure and standards of the American Arbitration sociation.

RTICLE 10 - PAYMENT. And it is agreed that, in consideration of the faithful and entire performance the Contractor of his obligations under this contract, the Owner shall pay to him, at the times and in manner hereinafter stipulated, the following named Contract Sum: _____

Five hundred forty thousand six hundred and 00/100 *

_____ Dollars ($ 540,600.00* _____).

ch contract sum shall be modified by such sums for alterations as may have been determined under the visions of Article 2 herein and diminished by such sums as the Owner may lawfully deduct and retain liquidated damages under the provisions of Article 5.

about the close of each month during which satisfactory progress has been made toward the final mpletion of the work, the Engineer will make an estimate of the amount and value of the work which been done under this contract during that month, or since the date of the last preceding estimate. ch estimate shall not be required to be made by strict measurement or with exactness, but may be de either wholly or in part by appraisement or estimation or by a consideration of accounts for labor d materials, and it shall be sufficient if it is approximate only. Any error or inaccuracy which may cur in any such progress estimate may be allowed for or corrected in any subsequent estimate.

e progress estimates and payments thus provided for will include all alterations which may be done der the provisions of Article 2 of this Agreement on the same basis as other work is included. All such rk is regarded as essentially a part of the contract and not merely an addition to it.

*See Page IvA.

YASTE ZENT & RYE inc.

November 7, 1977

City of Fort Wayne, Indiana
One Main Street
Fort Wayne, Indiana 46802

RE: Indiana Water Works Improvements, Wash Water Retention Basin, Contract #77-W-1

Gentlemen:

This letter is to certify that coverage has been bound on behalf of Hagerman Construction Corporation and is in full force and effect with the United States Fidelity and Guaranty Insurance Co. (USF&G) as of today's date, and as follows.

1) Builders Risk Insurance in the amount of $540,600 for the perils of Fire and Extended Coverage, written jointly in the names of City of Ft. Wayne and Hagerman Construction Corporation.

2) Owners Protective Public Liability insurance in the name of the Owner and the Engineer with limits of $500,000 per person and per occurrence for Bodily Injury Liability, and $100,000 per occurrence and $200,000 aggregate for Property Damage Liability.

Copies of these policies will be forwarded as soon as received from the insurance carrier.

Very truly yours,

YASTE, ZENT & RYE, INC.

Gerald A. Dahle

Gerald A. Dahle, CPCU
Vice President

GAD/cc

cc: Hagerman Construction Corp.

201 W. Wayne Street • P.O. Box 1367 • Fort Wayne, Indiana 46802 • Phone (219) 423-1591

CERTIFICATE OF INSURANCE

This is to certify that the policies listed in this Certificate have been issued to the Named Insured by the Company designated below. This Certificate does not amend, extend or otherwise alter the terms, conditions or exclusions of such policies.

Issued To (Name and Address)

City of Fort Wayne, Indiana
One Main Street
Ft. Wayne, Indiana 46802

Named Insured and Address: HAGERMAN CONSTRUCTION CORP.
P. O. BOX 690
FORT WAYNE, INDIANA 46801

Policy Number	Policy Term	Type of Insurance	Limits of Liability: Bodily Injury		Limits of Liability: Property Damage
3950-003161	4/1/77-78	Workmen's Compensation	Statutory		
3950-003161	4/1/77-78	Employers' Liability	$,000	Each Person	
			$100 ,000	Each Accident	
			$,000	Medical - Each Person	
1CC937555	4/1/77-78	Comprehensive Automobile Liability	$250 ,000	Each Person	
			$500 ,000	Each Occurrence	$100 ,000
1CC937555	4/1/77-78	Comprehensive General Liability	$500 ,000	Each Occurrence	$100 ,000
				Aggregate Operations	$200 ,000
		☐ Including Blanket Contractual Liability		Aggregate Protective	$200 ,000
			$500 ,000	Aggregate Completed Operations and Products	$200 ,000
		Manufacturers' and Contractors' Liability	$,000	Each Occurrence	$,000
				Aggregate	$,000
		Owners', Landlords' and Tenants' Liability	$,000	Each Occurrence	$,000
				Aggregate	$,000
		Completed Operations and Products Liability	$,000	Each Occurrence	$,000
			$,000	Aggregate	$,000
		Contractual Liability	$,000	Each Occurrence	$,000
				Aggregate	$,000
		Comprehensive Excess Indemnity	$,000	Each Occurrence	Combined Personal Injury and Property Damage
			$,000	Aggregate	

Description and location of operations and automobiles covered:

ANY AND ALL OPERATIONS OF THE NAMED INSURED.

PERTAINING TO: INDIANA WATER WORKS IMPROVEMENTS,
WASH WATER RETENTION BASIN,
CONTRACT # 77-W-1

The Company designated below will make every effort to notify the holder of this Certificate of any material change in or cancellation of these policies, but assumes no responsibility for failure to do so.

☒ UNITED STATES FIDELITY AND GUARANTY COMPANY

☐ FIDELITY AND GUARANTY INSURANCE UNDERWRITERS, INC.

Date Nov. 7, 1977

kn

By Harold A. Zelle

YASTE, ZENT & RYE, INC.

IN WITNESS WHEREOF, the parties hereto have set their hands and seals, in quadruplicate, this _____ day of _____, 19_____

WITNESS		OWNER
_____	BY	_____
_____	BY	_____
		CONTRACTOR
_____	BY	_____
_____	BY	_____

Approved as to Form:

_____

Owner's Attorney

INSTRUCTIONS FOR EXECUTING AGREEMENT

If the Contractor be a corporation, the following certificate should be executed.

I, _____, certify that I am the _____ Secretary of the corporation named as Contractor hereinabove; that _____, who signed the foregoing agreement on behalf of the Contractor, was then _____ of said Corporation; that said agreement was duly signed for and in behalf of said Corporation by authority of its governing body, and is within the scope of its corporate powers.

_____(Corporate Seal)

If the agreement be signed by the secretary of the corporation, the above certificate should be executed by some other officer of the corporation, under the corporate seal. In lieu of the foregoing certificate there may be attached to the agreement copies of so much of the records of the corporation as will show the official character and authority of the officers signing, duly certified by the secretary or assistant secretary under the corporate seal, to be true copies.

The full name and business address of the Contractor should be inserted and the agreement should be signed with his official signature. Please have the name of the signing party or parties typewritten or printed under all signatures to the agreement.

If the Contractor should be operating as a partnership, each partner should sign the agreement. If the agreement be not signed by each partner there should be attached to the agreemetn a duly authenticated power of attorney evidencing the signer's (signers') authority to sign such agreement for and in behalf of the partnership.

If the Contractor be an individual, the trade name (if the Contractor be operating under a trade name) should be indicated in the agreement and the agreement should be signed by such individual. If signed by one other than the Contractor there should be attached to the agreement a duly authenticated power of attorney evidencing the signer's authority to execute such agreement for and in behalf of the Contractor.

CITY OF FORT WAYNE, INDIANA

IMPROVEMENT TO FORT WAYNE WATER UTILITY

PERFORMANCE AND GUARANTY BOND

KNOW ALL MEN BY THESE PRESENTS, that we_____ (Contractor or Developer) as Principal, and the_____ (Insurance Company), a corporation organized under the laws of the State of _____(State and Date), and duly authorized to transact business in the State of Indiana, as Surety, are held firmly bound unto the City of Fort Wayne, Indiana, an Indiana Municipal Corporation in the sum of$_____, (value of work) for the payment whereof well and truly to be made, the Principal and the Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by those present. The condition of the foregoing obligation is such that

WHEREAS, the Principal has entered into contract with the City or has applied for authority to construct or cause to be constructed, a water main to become part of the City's water distribution system, which said water main is to be built and constructed according to plans and specifications prepared by or approved by City and known as the_____ (Name of Project) and,

WHEREAS, the grant of authority by City to so construct such water main provides:

1. That said water main shall be completed according to said plans and specifications, and there shall be filed with the City, within thirty (30) days after completion, a Completion Affidavit.
2. Said Principal is required to agree to make such adjustments, modifications, and repairs as required by the City within thirty (30) days after notice, and,
3. To agree to maintain said water main for a period of one (1) year following written acceptance by the City of said water main, and,

WHEREAS, said Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration, or addition to the terms of the contract or to the work to be performed thereunder, or the specifications accompanying the same, shall in any way affect its obligation on this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the contract, or to the work or to the specifications, and

WHEREAS, no change, modification, omission, or addition in and to the terms or conditions of said contract, plans, specifications, drawings, or profile, or any irregularity or defect in said contract or in the proceedings preliminary to the letting and awarding thereof shall in any way affect or operate to release or discharge said surety and the provisions and conditions of Chapter 258 of the Acts of the General Assembly of Indiana, of 1933, shall be, operate as, and become a part of the terms of this bond and said contract the same as if incorporated herein.

NOW THEREFORE, if the principal shall perform all of the terms and conditions required of it by the consent to cause said water main to become a part of the City water distribution system, and shall for one (1) year after acceptance of said water main by City maintain said water main and shall indemnify the City for all loss that City may sustain by reason of the Principal's failure to comply with any of the terms of the authorization, then this obligation shall be void, otherwise it shall remain in full force and effect.

_____
(Contractor or Developer)

By _____
(Principal)

_____
(Insurance Company)

By_____
Surety

STATE OF INDIANA:
SS:
COUNTY OF ALLEN:

BEFORE ME, a Notary Public, in and for said State, came

_____

as principal, and _____

of the _____

Attorney in Fact, for said _____

_____as surety, with both of whom I am personally acquainted, and acknowledged that they subscribed their signatures to the above and foregoing bond.

SUBSCRIBED TO, before me, a Notary Public, this _____ day of _____, 197__.

_____
Notary Public

My Commission Expires:

_____

Fort Wayne, IN 77-W-1

IN RE: WAGE SCALE

CODE: S-SKILLED
SS-SEMI SKILLED
US-UNSKILLED
IF-INDUSTRIAL FUND
PW-PER WEEK

We, the undersigned committee, being appointed to prepare a schedule of the prevailing wages to be paid in connection with, ALL CONSTRUCTION AND MAINTENANCE CONTRACTS AWARDED BY THE BOARD OF WORKS, CITY OF FT. WAYNE, INDIANA, DURING THE MONTHS OF JULY, AUGUST AND SEPTEMBER, 1977.
in compliance with the provisions of CHAPTER # 319 of the acts of the GENERAL ASSEMBLY of INDIANA, 1935, have established a schedule as hereinafter set forth for the following trades to wit;

TRADES OR OCCUPATION	CLASS	RATE PER HR.	H&W	PEN	VAC	APP	MISC.
ASBESTOS WORKER	S	11.40	35¢	55¢			3if
BOILERMAKER	S	11.70	80	1.00		3¢	
BRICKLAYER	S	10.34	45	50		1	4if
CARPENTER (BUILDING)	S	9.85		6%		7	2if
(HIGHWAY)	S	10.08	45	35		5	2if
CEMENT MASON	S	9.35	75	40		1	
ELECTRICIAN	S	11.30	40	1%+30		6	
ELEVATOR CONSTRUCTOR	S	10.18	49½	32	8%	2	
GLAZIER	S	9.53	12		40	4	25¢Holiday
IRON WORKER	S	10.75	75	85		1	2if
LABORER (BUILDING)	S-SS US	7.25-7.55	60	45		9	
(HIGHWAY)	S-US-SS	7.15-8.00	60	45		9	
(SEWER)	S-US-SS	7.15-7.95	60	45		8	
LATHER	S	8.20		25		1	2if
MILLWRIGHT & PILEDRIVER	S	10.18		6%		7	2if
OPERATING ENGINEER (BUILDING)	S-SS US	7.90-11.00	40	55		8	
(HIGHWAY)	S-SS-US	7.96-10.30	40	40		8	
(SEWER)	S-SS-US	8.00-10.30	40	40		5	
PAINTER	S	8.60-9.60	42	45		10	6¢misc.
PLASTERER	S	9.27	60	40			
PLUMBER & STEAMFITTER	S	11.35	45	75		7	4if
MOSAIC & TERRAZZO GRINDER	S	7.20-9.45					
ROOFER	S	9.45		10			
SHEETMETAL WORKER	S	10.54	40	35		4	13if
TEAMSTER (BUILDING)	S-SS US	8.68-9.63	23.00pw	28.00pw			
(HIGHWAY)	S-SS-US	8.23-8.83	23.50pw	28.00pw			

If any CLASSIFICATIONS ARE OMITTED IN THE ABOVE SCHEDULE, THE PREVAILING WAGE SCALE SHALL BE PAID. The above and forgoing shall shall be the minimum prevailing wage scale for this project as set by the wage scale committee, but in no way shall it prevent the contractor or sub - contractor from paying a higher rate of wages than set out in the schedule of wages on file.

DATED THIS 28 DAY OF June, 1977

Clayne T. Kepler
REPRESENTING GOVERNOR, STATE OF INDIANA.

REPRESENTING THE AWARDING AGENCY

REPRESENTING STATE A.F.L. & C.I.O.

SPECIFICATIONS

1. GENERAL REQUIREMENTS

GENERAL CONDITIONS

SCOPE OF WORK

The work under this Contract includes the furnishing of all labor, materials, equipment and construction equipment necessary for the construction of the work as described in the Advertisement, complete and in accordance with the Drawings and Specifications, prepared by McNamee, Porter and Seeley, Consulting Engineers.

CONTRACT DRAWINGS AND SPECIFICATIONS

The work to be done is shown on the accompanying set of Drawings prepared by McNamee, Porter and Seeley, Consulting Engineers, Ann Arbor, Michigan 48104. These original Drawings may be supplemented by other drawings furnished by the Contractor and approved by the Engineer. Additional drawings may be prepared by the Engineer and supplied to the Contractor during the progress of the work as he may deem to be necessary or expedient. These original and supplementary drawings constitute the Drawings according to which the work is to be done.

The Contractor shall keep at the site of the work an approved or conformed copy of all Drawings and Specifications and shall at all times give the Engineer or Owner and their representative access thereto.

Drawings and Specifications are deemed essential parts of this contract, and shall be construed as cooperative. Any work called for on the Drawings and not specifically mentioned in the Specifications or described in the Specifications and not particularly shown on the Drawings, is to be regarded as included under this contract the same as if fully set forth in the Specifications and exhibited on the Drawings. Where figures or definite dimensions are given on the Drawings or in the Specifications these shall have precedence over dimensions taken by scaling.

In case any inconsistency, omission, or conflict shall be discovered in either Specifications or Drawings, or if in any place the meaning of either or both shall be obscure, or uncertain, or in dispute, the Engineer shall decide as to the true intent and his decision shall be final and binding.

ENGINEERING DURING CONSTRUCTION

This work shall be subject to the approval of the Engineer, who shall determine the amount, quality, acceptability, and fitness of the several kinds of work and materials to be furnished hereunder and who shall decide all questions which may arise as to measurements of quantities and fulfillment of the requirements of the specifications.

CONTRACTOR'S ORGANIZATION

The Contractor shall establish and maintain an office on the site of the work, or at some convenient point adjacent thereto, during the continuance of this contract, and shall have at all times during working hours, a representative authorized to receive and execute any and all orders, when given by the Engineer; and such order, when given to and received by said representative shall be deemed to have been given to and received by the Contractor. Copies of the Shop Drawings shall at all times be kept on file by the Contractor at readily accessible points near the work.

RELATION TO OTHER CONTRACTORS

The Contractor shall so conduct his operations as not to interfere with or injure the work of other Contractors or workmen employed on adjoining or related work, and he shall promptly make good any injury or damage which may be done to such work by him or his employees or agents. Should a contract for adjoining work be awarded to another contractor, and should the work on one of these contracts interfere with that of the other, the Engineer shall decide which contract shall cease work for the time being and which shall continue, or whether work on both contracts shall continue at the same time and in what manner.

CONSTRUCTION BUILDINGS AND FACILITIES

Storage platforms, sheds, temporary closures for doors, windows and other openings of buildings, temporary sidewalks, runways and ladders, shall be furnished and installed. Hazardous areas shall be protected by guardrails and fences. Storage platforms and sheds shall be provided for materials which require protection from the weather. Sheds shall be substantially constructed and covered with "ready roofing". Doors, windows and other openings in the permanent work shall be closed as soon as necessary to safeguard the construction and materials from tampering or damage. Enclosures for openings easily accessible from the exterior shall be of solid wood or sash, provided with necessary hardware and padlocks. Other openings shall be enclosed by old sash or canvas on wooden frames for the protection of the building against damage by weather. Enclosures shall be weathertight and secured in such manner as not to damage the finish of the building.

SHOP DRAWINGS

Where called for in the specifications, the Contractor and the Fabricator or Supplier through the Contractor, shall submit to the Engineer for approval, in not less than six copies, details, specifications, cuts, schedules and drawings necessary for the fabrication, furnishing

and erection of such equipment and structural work as may be required. The Contractor shall make any change or alternations, to meet the requirements under the Contract, required by the Engineer and resubmit same without delay. The approval of the Engineer shall not relieve the Contractor of responsibility for errors in the drawings as the Engineer's checking is intended to cover compliance with the drawings and specifications and not to enter into every detail of the shop work.

Shop drawings of major assemblies shall be submitted in complete sets.

A separate transmittal shall be used for submittal of items under each specification section. Table of Contents and data sheets shall be included.

Shop Drawings should identify the detail as shown on the Contract Drawings and be complete as to the detail of the item and location in the project, materials, the thickness and size of members, the method of joining various components, the quantity, finish, the location and type of anchors, and should include necessary measurements. Shop assemblies which require markings for erection identification, should have easy-to-read markings on the shop and erection drawings. Variations in tolerances or clearance between various items and other materials should also be noted on the Shop Drawings.

Nameplate data for equipment including electric motors shall be included on Shop Drawings.

Shop Drawings shall indicate shop painting requirements to include type of paint and manufacturer.

Standard manufactured items in the form of catalog work sheets showing illustrated cuts of the items to be furnished, scale details, sizes, dimensions, quantity and all other pertinent information shall be submitted and approved in a similar manner.

Measurements given on the Shop Drawings or standard catalog sheets, as established from the Contract Drawings and as approved by the Engineer, shall be followed. When it is necessary to verify field measurements, they shall be checked and established by the Contractor. The field measurements so established shall be followed by the Contractor and by all affected trades.

It is also advisable for the fabricator or supplier to verify construction conditions and check measurements at the construction site especially if the item is to be installed by the fabricator or supplier. When this is the procedure, arrangements for checking and the responsiblity for measurements should be by mutual agreement.

The Contractor, when submitting drawings for approval, shall call to the attention of the Engineer any modifications or changes in the Drawings, as shown on the shop details, and give the reason for the modifications.

Attention is called to the fact that the Contractor shall submit Shop Drawings at the proper time to avoid delays, and in no case will the time for completion be extended on account of failure of the Contractor to submit Shop Drawings as required.

No work shall be undertaken until the Engineer has approved the Shop Drawings.

SPECIFICATIONS BY REFERENCE

Where reference is made in the specifications to standards of any technical society, association, governmental agency, etc., it is understood and agreed that such specifications or standards are a part of these specifications as though fully repeated therein.

The following listed letters or abbreviations shall be interpreted as indicated:

"AABC" - Associated Air Balance Council

"AMCA" - Air Moving and Conditioning Association

"AGA" - American Gas Association

"ASTM" - The American Society for Testing Materials

"AWWA" - American Water Works Association

"ASHRAE" - American Society of Heating, Refrigerating and Air Conditioning Engineers

"ANSI, ASA" - The American National Standards Institute (Formerly: The American Standards Association and U.S.A. Standards Institute)

"AISI" - The American Iron and Steel Institute

"ASME" - The American Society of Mechanical Engineers

"AWPA" - The American Wood Preserver's Association

"ACI" - American Concrete Institute

"AFBMA" - Anti-Friction Bearing Manufacturer's Association

"AGMA" - American Gear Manufacturer's Association

"CSA" - Canadian Standards Association

"FM" - Factory Mutual Engineering Corp.

"IEEE" - The Institute of Electrical and Electronic Engineers

"ISA" - The Instrument Society of America

"ISHD" - The Indiana State Highway Department

"NEC" - The National Electric Code

"NESC" - The National Electrical Safety Code

"NFPI" - The National Fire Protection Institute

"NEMA" - The National Electrical Manufacturers Association

"IPCEA" - The Insulated Power Cable Engineers Association

"OSHA" - Federal Occupational Safety and Health Act

"PCI" - Prestressed Concrete Institute

"SMACNA" - Sheet Metal and Air Conditioning Contractors National Association

"SSPC" - Steel Structures Painting Council

"UL" - Underwriters' Laboratories, Inc.

STANDARD SPECIFICATIONS
Reference to standard specifications of any technical society, organization, or association, or to codes of local or state authorities, shall mean the latest standard, code, specifications, or tentative specification adopted and published at the date of taking bids, unless specifically stated otherwise.

CODES, ORDINANCES, LAW AND REGULATIONS
The Contractor and Subcontractors shall observe and comply with all Federal, State and Local codes, ordinances, laws and regulations in force at the construction site, and shall protect and indemnify the Owner and the Owner's officers and agents against any claim or liability arising from or based on any violation of the same.

The Contractor shall pay for and obtain all building permits, licenses for the work, pay all charges for inspection and tests, and file plans and specifications to the inspection department having jurisdiction.

LINES AND GRADES
The Engineer will set suitable base lines and reference elevations for the various parts of the work. The Contractor shall provide stakes and such suitable labor and assistance as the Engineer may require in setting the above. No work shall be undertaken until such stakes and marks shall have been set by the Engineer. The Contractor shall take due and proper percautions for the preservation of these stakes and marks and shall see to it that the work at all times proceeds in accordance therewith. The Contractor shall provide all construction lines and grades for his work.

UTILITIES
Unless otherwise provided in these specifications, the Contractor shall make his own arrangements for electricity, gas, water and sewer services for use during the construction of the work and shall pay for all connections, extensions and services.

PUBLIC AND PRIVATE UTILITIES
Where any utilities, water, sewer, gas, telephone, or any other either public or private, are encountered, the Contractor must provide adequate protection for them and he will be held responsible for any damages to such utilities arising from his operations.

When it is apparent that construction operations may endanger the foundation of any utility conduit, or the support of any structure, the Contractor shall notify the utility owner of this possibility and he shall take such steps as may be required to provide temporary bracing or support of conduits or structures.

Where it is the policy of utility owners to make repairs to damaged conduit or other structures, the Contractor shall cooperate to the fullest extent with the utility and he shall see that his operations interfere as little as possible with those operations.

When it is necessary in order to carry out the work, that an electric, telephone, or light pole be moved to a new location, or moved and replaced after construction, the Contractor shall arrange for the moving of such poles and the lines thereof, and shall pay any charges therefore.

Where existing sewers or drains are encountered along the line of work, the Contractor shall perform his operations in such a manner that service will not be interrupted; and shall, at his own expense, make all temporary provisions to maintain service.

Unless otherwise indicated on the Drawings, the Contractor shall replace any disturbed sewer or drain, or relay same at a new grade to be established by the Engineer such that sufficient clearance for the sewer will be provided.

The Contractor will receive no extra compensation for replacement of sewers or drains encountered, or for relaying at a new grade and/or line where necessary, except where specifically noted otherwise on the Drawings or in the Specifications.

Where existing gas mains and services are encountered, the Contractor shall arrange with the gas company for any necessary relaying, and shall pay for the cost of such work.

Materials used in repairing or relaying utilities shall be of the same type and strength as the existing work.

SUBSURFACE UTILITIES
The location and size of sewers, drains, culverts, gas and water mains, electric and telephone conduits and other underground conduits and structures are shown on the Drawings. This information has been obtained in part from field surveys and in part from records of the Owner or other available records. This information is made available to the bidder as an indication of conditions as existing. The bidder shall assume full responsibility for the interpretation of this information in connection with the Contract. Contractors are advised that the Owner does not guarantee the size, location, quantity or number of underground utilities. Those shown on the Drawings are based on available data but should not be regarded as conclusive.

The Contractor shall be responsible for verifying the location of all underground utilities by magnetic or other type instruments before beginning excavation work.

GAS
If gas is present in existing sewers where the Contractor must work, the sewer shall be cleared of gas before entering. If the gas cannot be removed by natural ventilation, by the removal of manhole covers, the Contractor shall maintain forced draft to render the sewers safe as determined by gas detection equipment.

DRINKING WATER
The Contractor shall at all times provide for his employees an abundant and convenient supply of cool drinking water, taken from some safe and wholesome source.

SANITARY REGULATIONS
The Contractor shall provide at convenient points, properly secluded from observation, a sufficient number of toilets for the use of the employees and shall maintain them strictly without nuisance and without offense to the public or to residents in the vicinity of the work. The number, location, character, condition and maintenance of these facilities must at all times be such as will meet the approval of the Engineer.

CONTROL OF NOISE
The Contractor shall eliminate noise to as great an extent as possible at all times. Air compressors shall be equipped with silencers and the exhaust of all gasoline motors and other power equipment shall be provided with mufflers. In the vicinity of hospitals, libraries and schools, special precautions shall be taken to avoid noise and other nuisance, and the Contractor shall require strict observances of all pertinent ordinances and regulations. Any blasting permitted in such locations shall be done with reduced charges.

SMOKE PREVENTION
Strict compliance with all ordinances regulating the production and emission of smoke will be required and the Contractor shall accept full responsiblity for all damage that may occur to property as a result of negligence in providing required control.

Burning of waste materials resulting from the work under this contract will not be allowed unless authorized in writing by the Owner. Where burning is not allowed, the Contractor shall haul all waste materials from the site and dispose of same in a manner acceptable to the Engineer. The costs of hauling and disposal of waste materials shall be incidental to the work under this contract.

DUST CONTROL
The Contractor shall apply water or dust palliative, or both, for the alleviation or prevention of dust nuisance caused by his operations. Dust control operations shall be performed by the Contractor at the time ordered by the Engineer, but failure of the Engineer to issue such order will not relieve the Contractor of his responsibility. No direct payment will be made for any such work performed or material used to control dust under this Contract.

STORAGE OF EQUIPMENT AND MATERIAL
Pumps and other machinery units shall be stored in weathertight structures furnished by the Contractor. Motors, electrical switchgear, gauges and other equipment of a delicate nature, as determined by the Engineer, shall be stored in weathertight warehouses which are maintained at a temperature of at least 60°F. Structural steel, miscellaneous and cast iron items may be placed in open yard storage, but any such items having attached motors or other machinery units shall have such units well wrapped with waterproof paper or cloth for protection from the weather.

Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. All painted surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of the Engineer.

Materials and equipment distributed, stored and placed upon or near the site of the work shall at all times be so disposed as not to interfere with work being prosecuted by other Contractors in the employment of the Owner or with street drainage and not to hinder any more than necessary the ordinary traffic of the streets.

MONUMENTS

Under this section, the term "monument" shall be considered as any object defining the location of a property corner, street location, section line, fractional section line, right-of-way marker or other delineation of land ownership or division.

During the progress of work, the Contractor may encounter monuments within his working area. A minimum number of such points have been located by the Engineer prior to construction, to provide control for the preparation of construction Drawings and these are noted on the Drawings. All probable monument points, as so far as known, have been indicated on the Drawings as property, street and/or section line intersection points.

The Contractor, prior to actual construction, shall erect protective barricades around all ascertained monuments that are in or adjacent to the construction area. Any other monument uncovered or located during progess of the work shall be protected from damage or loss and the Engineer shall be notified in writing as to the exact location.

During the normal course of the work monuments may require removal. The Contractor shall not remove any such monument until the Engineer shall have set four iron pipe stakes each two feet long as reference points for the resetting of such monument. Reference stakes shall be located in such positions and barricaded so that they will not be disturbed by any construction operations. The Contractor shall furnish the necessary iron pipe stakes, barricades, necessary labor and other assistance required by the Engineer for his work in setting the reference stakes. After this referening has been done and permanent sketches prepared, the Engineer will give permission to the Contractor for the removal of the monument. Referenced monuments will be reset by the Owner after all backfilling has fully settled.

Any monuments damaged or destroyed by the Contractor, that are not within the normal work area as determined by the Engineer, shall be replaced and the Contractor shall pay all costs of the replacement survey. The replacement survey shall be performed by, or under, the direct supervision of a Registered Land Surveyor, licensed by the State in which the work is performed.

MAINTENANCE OF TRAFFIC

During the progress of the work, the Contractor shall accommodate both vehicular and pedestrian traffic as provided in these specifications and as indicated on the Drawings. In the absence of specific requirements, he shall maintain such traffic. Access to fire hydrants, water and gas valves shall always be maintained. The Contractor's truck and equipment operations on public streets shall be governed by all local traffic ordinances and regulations of the Fire and Police Department and the Department of Public Works.

PROTECTION OF WORK AND PROPERTY

The Contractor shall continuously maintain adequate protection of all his work from damage and shall protect all public property and private abutting property from injury or loss arising in connection with this contract. He shall, without delay, make good any such damage, injury, or loss, and shall defend and save the Owner harmless from such damages or injuries occurring because of his work. He shall furnish and maintain protected pedestrian sidewalks, passageways, barricades, guard fences, lights and danger signals, provide watchmen and other facilities for protection required by public authority, by local conditions, or by order of the Engineer, at no additional cost to the Owner. Protection of the work, including property and persons within the county and public right-of-way, shall be in accordance with the current edition of the State Manual of Uniform Traffic Control Devices.

RESPONSIBLITY FOR ADJOINING STRUCTURES

The Contractor shall assume full responsibility for the protection of pavements, curbs, poles and any other surface structures and water mains, sewers, and structures along and near the work which may be affected by his operations, and shall indemnify, defend and save harmless the Owner against the damages or alleged damages to any such structure arising out of his work. The Contractor shall bear the cost of repair or replacement of any such structure damaged as a result of his operations. Damaged structures shall be repaired or replaced to the condition at the time of damage. Such repair or replacement shall be made by the Contractor or by the owner of the structures as directed by the Engineer.

PROTECTION OF TREES AND SHRUBBERY

No trees or shrubbery of any kind shall be removed or destroyed by the Contractor without the written permission of the Engineer, unless removal is indicated on the drawings, and the Contractor will be held fully responsible for any damages caused by his work to adjoining trees and shrubs. Ample precautions shall be taken by the Contractor to protect such trees and shrubs as are to remain in place by surrounding them with fences or other protection before construction work begins. Shrubbery that has to be removed shall be preserved and replaced in a manner acceptable to the Engineer.

PROTECTION AGAINST DAMAGE TO WORK

The Contractor shall assume full responsibility for loss or damage to the work during the entire construction period resulting from caving earth and from storms, floods, frosts, and other adverse weather conditions, and from other causes whatsoever not directly due to the acts or neglect of the Owner and shall turn the finished work over to the Owner in good condition and repair, at the time of the final estimate. This responsibility of the Contractor shall cover those elements included as alter-

ations under this contract in exactly the same manner as the regular work is covered.

CLEANING UP
The Contractor shall at all times keep the premises free from accumulations of waste material or rubbish caused by his employees or work. Upon completion of the actual work of construction, the Contractor shall clean up and leave in a neat condition the premises which he has occupied during the construction period. Before the time of the final estimate, the Contractor shall remove from the premises surplus excavation, debris and rubbish and all unused materials, together with tools and equipment, or shall deposit them at such points and in such manner, as the Engineer may require.

SUNDAY AND NIGHT WORK
Ordinarily no Sunday or night work shall be carried on which will require the presence of the Engineer or an inspector, except with the written permission of the Engineer. Sunday and night work is permissible in an emergency to the extent required to meet the emergency, but the Contractor shall notify the Engineer, as far as possible in advance, of his intention to carry on such emergency work and of the time and place of doing it.

DISCRIMINATION
The Contractor shall not discriminate against any employee or applicant for employment in the performance of this Contract, with respect to his race, color, religion, national origin or ancestry and the Owner will require a similar covenant on the part of a Subcontractor employed in the performance of this Contract.

SAFETY
The Contractor and Subcontractors shall comply with federal, state and local laws and regulations governing the furnishing and use of safeguards, safety devices, and protective equipment, and take any other needed actions on his own responsiblity or as directed by the Engineer as reasonably necessary to protect the life and health of employees on the job and safety of the public and to protect property during the construction of the project.

The "Safety and Health Regulations for Construction" and subsequent amendments promulgated by the U.S. Dept. of Labor must be followed on the construction of this project. These regulations are identified as Chapter XVII of Title 29, Code of Federal Regulations (CFR), Part 1926.

FIRST AID
The Contractor shall keep upon the site, at each location where work is in progress, a completely equipped first aid kit and shall provide ready access thereto at all times when men are employed on the work.

GENERAL REQUIREMENTS FOR MATERIALS AND WORKMANSHIP
Unless otherwise stipulated in the specifications, all equipment, materials and articles incorporated in the work covered by this contract are to be new and of the best grade of their respective kinds for the purpose. The Contractor shall, if required, furnish such evidence as to kinds and quality of materials as the Engineer may require.

The Contractor shall furnish suitable tools and building appliances to perform the work to be done, and any tools or appliances that shall not, in the judgement of the Engineer, be suitable or competent to produce this result may be ordered from the work by him and such tools or appliances shall be substituted therefor by the Contractor as will meet with the approval of the Engineer.

Equipment shall be erected in a neat and workmanlike manner on the foundations at the locations and elevations shown on the Plans, unless directed otherwise by the Engineer during installation. All equipment shall be correctly field aligned, leveled and adjusted for satisfactory operation and shall be installed so that proper and necessary connections can be made readily between the various units.

The Contractor shall furnish, install and protect all necessary anchor and attachment bolts and all other appurtenances needed for the installation of the devices included in the equipment specified.

The Contractor shall employ only workmen who are competent to perform the work assigned to them and, in the case of skilled labor, who are adequately trained and experienced in their respective trades and who do satisfactory work. Whenever the Engineer shall notify the Contractor that any man on the work is, in his opinion incompetent, unfaithful, or disorderly, or who uses threatening or abusive language to any person representing the Owner when on the work, such man shall be immediately discharged from the work and shall not be re-employed thereon except with the consent of the Engineer.

If not otherwise provided, material or work called for in this contract shall be furnished and performed in accordance with well-known established practice and standards recognized by Architects, Engineers, and the trade.

TESTING
All design, material and performance testing costs, except soil density and compaction tests, shall be made at the expense of the Contractor. Testing costs shall include all manpower, equipment and handling costs, including collection, transportation and storing.

Contractor shall obtain the services of a certified testing laboratory approved by the Engineer. This testing laboratory will perform all design and material testing required.

For materials covered by ASTM, AWWA, State and/or Federal Specifications, the required tests are to be made by the manufacturer or supplier and his certificates submitted to the Engineer.

A minimum of 3 copies of all test results shall be furnished to the Engineer.

SAMPLES

Where called for in the specifications, samples of materials in the quantity required shall be submitted to the Engineer for approval. The work shall be in accordance with approved samples.

Where samples are requested or items are required to be approved by the Engineer, the Contractor shall make written request at least three weeks before approval is required and obtain approval in writing from the Engineer before ordering such materials. Attention is called to the fact that the Contractor shall request approvals at the proper time to avoid delays, and in no case will the time for completion be extended on account of failure of the Contractor to request approvals or submit samples as required.

Samples are to be forwarded to the Engineer with all shipping charges prepaid, boxed or wrapped separately and each labeled with the name of the material, the name of the producer, the Contractor furnishing same and the name of the building for which the material is intended.

The approval of the samples is generally for quality, color and finish, and does not modify the requirements of the specifications or drawings as to dimensions and design.

ERECTION OF EQUIPMENT

Equipment shall be erected in strict conformity with the manufacturers' drawings and instructions. Equipment shall be erected by mechanics experienced in the erection and operation of machinery equipment.

MOVING EQUIPMENT

All heavy equipment moved over improved streets shall be transported on equipment railers or moved over planking placed on the paving and as directed by the Engineer.

PLACING EQUIPMENT IN OPERATION

It is the intent in these specifications to provide operating units complete and ready to be put into the Owner's service. Mechanisms shall be properly lubricated and adjusted and all electrical connections and devices shall be tested for proper erection and performance. Where the medium to be handled is available, a test run shall be made to demonstrate the workability of the equipment. Where no such medium is available the equipment shall be run "dry," if that is feasible. All necessary oils, greases, and special lubricants shall be provided.

After the completion of the erection, the Contractor shall maintain the equipment until it is accepted by the Owner. Machinery shall be operated at least once each week to insure proper grease distribution to bearings and other mechanical parts. Spare parts, lubricants and operating instructions shall be segregated and labeled before being turned over to the Owner.

GUARANTEE

Where called for in the specifications, the Contractor shall secure for and furnish to the Owner, a written guarantee that all equipment and all parts thereof, material and/or workmanship shall be first class and free from defects and that the guarantor will, upon notice and without undue delay, without expense to the Owner, make good or repair, the whole or any part of the work which shall, within the indicated time after the date of acceptance of the completed work, fail or develop unfitness for the purpose for which it is intended, as a result of any defect in design, material or workmanship. Where no time limit is shown it shall automatically imply one year. Upon completion of the work the Contractor shall furnish the Engineer a tabbed binder containing all guarantees for each piece of equipment or item as herein required. When requested by the Engineer, the manufacturer's guarantee shall be attached to the Contractor's guarantee.

TIME AND SEQUENCE OF WORK

In general, it is the intention and understanding that the Contractor shall have control over the sequence or order of execution of the several parts of the work to be done under the Contract and over the method of accomplishing the required results, except as some particular sequence or method may be distinctly demanded by the Drawings and Specifications or by the expressed provisions of the Contract. The Engineer may, however, make such reasonable requirements as may, in his judgment be necessary for the proper and effective protection of work partially or wholly completed and to these requirements the Contractor shall conform.

MAINTENANCE OF SERVICE

The Contractor shall so arrange his work that at no time will it cause any unnecessary interruption to the operation of the present water treatment plant.

When construction operations must be done with any portion of the existing plant out of service, such work shall be done at such times and in the sequence as directed by the Engineer. During such period of curtailment of plant operation the work shall be done with all haste possible under the circumstances, even to the extent of working continuously 24 hours a day for this period.

A suggested sequence of construction is presented in the Instructions to Bidders. If the Contractor wishes to propose an alternate plan for maintaining continuous plant flow and treatment, he shall submit complete details of his plan to the Engineer for approval.

PROGRESS PHOTOGRAPHS

During the progress of the work, photographs shall be taken at the rate of at least four every month from start of construction until acceptance by the Owner. These photographs shall be taken from points and at the times directed by the Engineer.

Two glossy-finish prints of each negative shall be furnished to the Engineer. Photographs shall be approximately 7½ by 9½ inches overall. Each print shall be labeled in one corner of the print face with a title block (3-inch x 1½-inch) similar to:

(Name of Owner)

(Contract Name)

(Contract Number)

(Name of Contractor)
(Description of Photograph)

_____

_____

Photo No. Date
McNamee, Porter and Seeley, Engineers

Each print shall be inserted in a cellophane or similar material, transparent sheet protector, provided with reinforced holes for mounting in a three-ring binder.

Two binders of sufficient size for filing sets of prints shall be furnished the Engineer. Binders shall be three-ring, black, with size based on number of prints anticipated.

Upon completion of the job the negatives shall become the property of the Owner.

SOIL EROSION AND SEDIMENTATION CONTROL

The Contractor shall take all precautions necessary to prevent soil erosion of areas disturbed by the construction and shall insure that all soil erosion be contained within the construction site. The Contractor shall provide temporary slope protection, temporary dikes, etc., as required to prevent eroded materials from entering any sewers or natural water courses.

Should the local regulatory agency determine that the construction operation is in violation of the applicable Soil Erosion and Sedimentation Control Ordinances, and cites the Owner, the Contractor shall take immediate action, as directed by the Owner, to insure compliance with same.

SCOPE OF WORK
These General Equipment Stipulations apply, in general, to all equipment furnished under Specification sections. They shall supplement the detailed equipment specifications but in case of conflict the equipment specifications shall govern. All costs for this work shall be included in the prices quoted by equipment suppliers.

COMPLIANCE WITH OSHA
All equipment furnished under this Contract shall meet all the requirements of the Federal and/or State Occupational Safety and Health Acts. Each equipment supplier shall submit to the Engineer certification that the equipment furnished is in compliance with OSHA.

SHIPPING AND HANDLING EQUIPMENT
All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment and handling.

LUBRICATION
Equipment shall be adequately lubricated by systems which require attention no more often than weekly during continuous operation. Lubrication systems shall not require attention during start-up or shutdown and shall not waste lubricants.

Lubrication points shall be easily accessible with all points of application provided with standard fittings for greasing or placing oil.

Lubricants of the type recommended by the equipment manufacturer shall be provided in sufficient quantity for all consumption prior to completion of required testing and acceptance of equipment by the Owner.

SAFETY GUARDS
All belt or chain drives, fan blades, couplings, vertical or horizontal drive shafts and other moving or rotating parts shall be covered on all sides by a safety guard. Safety guards shall be fabricated from 16 gauge or heavier galvanized or aluminum-clad sheet steel or ½-inch mesh galvanized expanded metal. Each guard shall be designed for easy installation and removal and painted safety yellow. All necessary supports and accessories shall be provided for each guard. Supports and accessories, including bolts, shall be hot dip galvanized. All safety guards in outdoor locations shall be designed to prevent the entrance of rain and dripping water.

ANCHOR BOLTS
All necessary anchor bolts shall be furnished as per the manufacturer's recommendations and shall be made of ample size and strength for the purpose intended. Anchor bolts, nuts and washers shall be hot-dip galvanized in conformity with ASTM A153 and A385 and be supplied with sleeves. Substantial templates and working drawings for installation shall be furnished. Two nuts shall be furnished.

Unless otherwise shown or specified, anchor bolts for items of equipment mounted on baseplates shall be long enough to permit 1½ inches of grout beneath the baseplate and to provide adequate anchorage into structural concrete.

SPECIAL TOOLS, SPARE PARTS AND ACCESSORIES
Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Spare parts where specified shall be furnished. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.

SHOP PAINTING
All iron and steel surfaces shall be protected by suitable paint or coatings applied in the shop or at point of fabrication. Surfaces which will be inaccessible after assembly shall be protected for the life of the equipment.

All iron and steel surfaces which will be totally or partially submerged or located in a continuously or intermitent moist atmosphere during normal operation shall be shop blast cleaned to a near-white finish, removing all dirt, rust-scale and foreign matter by any of the recommended methods outlined in the Steel Structures Painting Council Specification SP-10. The cleaned surfaces shall be shop primed before any rust bloom forms. All other exposed surfaces shall be properly filled, scrapped, sanded, etched, brushed, sandblasted and/or cleaned to provide surfaces free from dirt, loose crystals, rust, scale, oil and grease and shop primed.

Shop primed surfaces shall be painted with one or more coats of a universal rust-inhibitive primer which can be used on both submerged and nonsubmerged iron and steel and has the ability to accept alkyds, epoxy, vinyl, coal tar, chlorinated rubber, emulsion, coal tar epoxies, epoxy ester, asphalt and phenolic paints as finish coats. Minimum shop coat thickness shall be 1.5 dry mils. Shop primers shall be Mobile "13-R-50 Chromox Q.D. Primer," Tnemec "77 Chem-Prime" or equal.

Sluice gates shall be factory painted with coal tar.

The exterior surfaces of all ground buried valves shall receive a coal tar or bituminous coating in accordance with the manufacturer's standards. The inside surfaces of all valves shall be coated with coal tar pitch varnish in accordance with the latest AWWA Specifications.

Electric motors, speed reducers, starters, pumps, motor control centers, control panels and other self-contained or enclosed components shall be shop finished with two coats of an enamel paint as per the manufacturer's recommendations.

Where specified steel and iron surfaces shall be hot dipped galvanized in conformity with ASTM A153 and A385.

Machined, polished and nonferrous surfaces which are not to be painted or galvanized shall be coated with rust preventative compound, equal to Dearborn Chemical "No-Ox-ID2W", Houghton "Rust Veto 344", or Rust-Oleum "R-9".

SEALS

Mercury seals will not be acceptable.

OPERATION, MAINTENANCE AND LUBRICATION INSTRUCTIONS AND PARTS LISTS

All equipment suppliers shall submit to the Engineer, through the Contractor, four copies of a manual containing specifications, drawings and descriptions of equipment; installation instructions; operation, maintenance and lubrication manuals; parts lists; and where applicable, test data with curves, wiring diagrams and schematics. This information shall be submitted for each item of equipment furnished under this Contract.

These manuals shall be in addition to any instructions shipped with the equipment and shall be submitted only after the Engineer has given final approval of the Shop Drawings. These manuals shall be submitted to the Engineer not later than the date of shipment of the equipment to the job site. Each manual shall be bound in a heavy fiberboard or hard-back cover having indicated thereon the type of equipment, manufacturer's name and year of purchase. An index to the information contained therein shall be bound inside the front cover of each manual.

INSTALLATION CHECK

An experienced, competent, and authorized representative of the manufacturer or supplier of each item of equipment shall visit the site of the work a minimum of two times, once prior to installation to review installation procedures with the Contractor and once after installation to inspect, check, adjust if necessary, and approve the equipment's installation. The equipment supplier's representative shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation is satisfactory to the Engineer.

Manufacturer's representative will provide all necessary tools and testing equipment required including noise level and vibration sensing equipment.

Each equipment supplier's representative shall furnish to the Owner, through the Engineer, a written report certifying that the equipment (1) has been properly installed and lubricated; (2) is in accurate alignment; (3) is free from any undue stress imposed by connecting piping or anchor bolts; (4) has been operated under full load condition and that it operated satisfactorily to the Engineer; (5) that the Owner's representative has been instructed in the proper maintenance and operation of the equipment; and (6) furnish the Owner a copy of all test data recorded during the installation check including noise level and vibration readings.

ELECTRIC MOTORS

Motor design and application shall comply with current ANSI, IEEE, NEMA and AFBMA standards and with the NEC where applicable. They shall be squirrel cage induction motors rated 60 hertz, continuous duty for use in a 40° C ambient temperature.

The motors shall be sized within their rated loads under the specified conditions without utilizing the top 15 percent of the 1.0 or 1.15 service factor. Motor sizing measured at the motor output shaft shall include all loadings on the motor. Motor loading shall include the maximum or specified load condition of the driven equipment plus all drive losses of components, located between the motor and the driven equipment.

The motor winding temperature rise shall be NEMA Standard for the class of insulation used at the rated service factor load.

Motors 50 Hp and larger shall have embedded passive temperature switches in the windings for use in the motor control circuit that will limit the winding temperature as defined by NEMA Standard MG-1-12.53 Type 1. The contact shall be normally open and rated to operate a 120 VAC control relay (40 VA).

Motors shall have oversize conduit boxes with clamp type grounding terminals inside which are effectively connected to all non-current carrying motor parts.

Motors shall be standard design and construction unless otherwise specified and shall be manufactured by Continental Electric Co. Inc., General Electric, Louis Allis, Reliance Electric Co., Sterling Powers Systems, Inc., U.S. Motors, Westinghouse, or equal. For motors that are integrally constructed as a piece of equipment such as appliances, handtools, etc., and where the manufacturer would be required to redesign his equipment to meet these general specifications, it is the intent to allow such standard motors to be used provided they do not exceed 1½ horsepower and are suitable for use on standard power systems.

All explosion proof motors shall meet NEC Class 1, Division I, Group D, requirements with T2A temp. rating.

Unless these general specifications are supplanted by the detailed equipment specifications, motors shall be rated and constructed as follows:

a. Below ½ Hp, motors shall be rated 115/230 volts, single phase but shall be suitable for use on 208 volt power system. They shall have permanently lubricated sealed bearings (antifriction type where high radial or axial thrusts are produced by the driven equipment). Standard motors shall be totally enclosed fan cooled, totally enclosed air-over or totally enclosed non-ventilated capacitor start type. Totally enclosed explosion-proof motors shall be provided where required per equipment specifications section.

b. From ½ Hp to 1½ Hp, motors shall be rated 115/230 volts single phase or shall be rated 230/460 volts three phase as indicated by the equipment schedule(s). In either case they shall be suitable for use on 208 volt power systems under their given load conditions. They shall have bearings as in (a) above. The standard enclosure shall be totally enclosed, fan cooled, totally enclosed non-ventilated, or totally enclosed explosion-proof or open dripproof motors shall be provided where required per equipment specification sections.

c. From 2 to 200 horsepower, motors shall be rated 230/460 or 460 volt three phase. They shall be grease lubricated, ball bearing, Class B insulated minimum or as specified. Horizontal motors shall be open drip proof, totally enclosed fan-cooled or totally enclosed explosion-proof (NEC Class I: Group D) as shown on the equipment schedule. Vertical motors shall meet NEMA standard open drip proof specifications as a vertical motor when called for or totally enclosed fan-cooled or totally enclosed explosion-proof as shown on the Equipment Schedule.

   Horizontal and vertical motors may also be weather protected type I and shall have encapsulated or sealed windings.

   Open drip proof type motors shall have encapsulated or sealed windings when called for in the Schedule.

   Special duty and severe environment application shall have motors which are designed specifically to meet the special conditions as specified.

d. All motors above 200 horsepower shall be of special design as detailed in specific sections of the specifications. All special purpose motors such as wound-rotor, multi-speed, variable speed, etc. shall be as detailed in specific sections of the Specifications.

e. The following symbols will be employed in the equipment Schedules to indicate the required motor enclosure and construction features:

   TE - Totally Enclosed may be non-ventilated, fan cooled or air-over type
   TENV - Totally Enclosed Non-Ventilated
   TEFC - Totally Enclosed Fan Cooled
   TEEP - Totally Enclosed Explosion-proof Class I, Div. I, Group D
   ODP - Open Drip Proof
   WPI - Weather Protected Type I
   E/S - Encapsulated or Sealed Windings

   (All motors with encapsulation or sealed windings shall have a watertight conduit box.)

   See NEMA Standard MGI for definition of above terms.

MOTOR STARTERS

Motor starters 480 volt or less shall be size one or larger and have 120 VAC contactor coils. All control circuits and indicating lights associated with the starter shall be 120 volt. The control transformer shall be sized to have 100 VA minimum spare capacity for future use. A terminal strip shall be provided for all control wires entering the starter with spare terminals for future use. The terminal strip and wires shall be identified. One spare normally open auxiliary starter contact, wired to the terminal strip, shall be provided for future use. Indicating lights shall be 120V, oil tight, push-to-test type. Explosion proof units shall meet NEC Class I, Division I, Group D requirements.

EQUIPMENT BASES

A cast iron or welded steel baseplate shall be provided for all equipment and motor assemblies. The baseplate shall be installed on a concrete base. Each baseplate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have a threaded drain connection. Bases shall be fully braced to withstand shock loads and resist buckling. Necessary safety guard mountings shall be furnished as part of the equipment base. Baseplates shall be anchored to the concrete base with suitable anchor bolts and grouted in place.

LADDERS

All ladders shall meet the requirements of OSHA. Ladders shall be aluminum construction unless otherwise specified or noted on the Drawings.

Ladders shall be of the heavy duty industrial type with 1¼-inch rungs, 22-inches wide at 12-inch centers. All necessary mounting hardware shall be furnished. Non-aluminum items furnished shall be of galvanized or stainless steel construction.

Where required, aluminum safety cages shall be furnished.

WALL AND SLAB SLEEVES AND CASTINGS

Unless otherwise shown on the Drawings or specified, at all points where pipes or conduit pass through walls, slabs or roofs, suitable sleeves or casings shall be furnished and installed.

Sleeves and castings shall not be painted in areas to be embedded in the concrete. All loose rust, scale, grease or oil shall be removed prior to pouring the concrete.

Where water or gas tightness is essential and at other locations wehre indicated, wall castings and sleeves shall be provided with an intermediate flagne located approximately at the center of the wall or slab.

All sleeves and castings shall be flush with walls and underside of slabs but shall extend 2-inches above finished floors.

Unless oterwise shown or approved by the Engineer, the space between the pipe and the sleeve shall be caulked. All ground buried and water or gas retaining wall or slab sleeves or castings shall be caulked with lead and oakum or be mechanical joint.

ELECTRICAL CODES, ORDINANCES AND INDUSTRIAL STANDARDS

The design, testing, assembly, and methods of installation of the wiring materials, electrical equipment and accessories proposed under this Contract shall conform to the National Electric Code and to applicable state and local requirements. UL listing and labelling shall be adhered to under this contract.

Any equipment that does not have a UL, FM, CSA, or other approved testing laboratory label shall be furnished with a notorized letter signed by the supplier stating that the equipment furnished has been manufactured in accordance with the National Electric Code and OSHA requirements.

Any additional cost resulting from any deviation from codes or local requirements shall be borne by the Contractor.

2. EARTHWORK

GENERAL

SCOPE OF WORK

This work shall include all excavation and backfilling for all structures.

This work shall be subject to the conditions of the General Requirements and include the furnishing of all labor, materials, and equipment for the construction of sheet piling and the handling of all excavation and backfill, including all operations incidental thereto such as clearing and grubbing, sheeting, bracing, shoring, diking, cofferdamming, dewatering, drainage and finish grading.

SHOP DRAWINGS AND GUARANTEES

Furnish, as prescribed under the General Requirements, Shop Drawings and Guarantees covering the items included under this section of the work.

EARTHWORK

CLEARING AND GRUBBING

The areas required for construction for the proposed structures, roadways, etc., shall be cleared of all trees, stumps, roots, brush, rubbish and other objectionable matter. Such materials from clearing operations shall become the property of the Contractor and shall be removed from the site as specified hereinafter under disposal of excess materials. The Engineer will designate areas to be cleared.

EXCAVATION

Preservation of Soil. In making the excavation for the structures, top soil found to be suitable shall be removed and stored in a separate pile and preserved for use in selected grading around and over the structures. Granular soil found to be suitable for filling the ground adjacent to steel sheet piling or structures shall be removed and stored in separate piles preserved for this use. Trash and other materials of all kinds, unsuitable in the judgement of the Engineer, for dikes, roadways or backfilling adjacent to and over structures and all excess excavated material shall be removed from the construction area and disposed of off the site as specified hereinafter. If the quantity of useable material is insufficient to meet the finished grades shown on the Drawings, the Contractor shall obtain the required amount of the loose earth, sand, or gravel from outside sources without cost to the Owner.

Excavation. Excavation may be made by any practicable method consistent in the judgement of the Engineer, with the integrity and protection of the work, adjoining work or property and the protection of the workmen and the public. If, for proposed structures, excess excavation is made or the material becomes disturbed so as to require removal beyond the prescribed limits to a depth of not more than 6-inches below such structures, the resulting space shall be refilled with selected material solidly tamped into place and any space beneath footings shall be backfilled with Class C concrete, as hereinafter specified, before the construction work proceeds. If, in excavation for non-pile supported structures, excess excavation is made to a depth greater than 6-inches, it shall be completely backfilled with Class C concrete, under all wall and column footings; and with granular materials compacted to 100% maximum density in layers not to exceed 9 inches under slabs. Excavation for structures shall be extended sufficiently beyond the limits of the structures to provide ample room for form construction and for practicable construction methods to be followed.

Additional Excavation Below Finished Subgrade. Where the finished subgrade of non-pile supported structures, in the opinion of the Engineer, is not sufficiently stable for supporting foundations, grade slabs, or piping, the Contractor shall excavate to the elevations and lines directed by the Engineer and he shall backfill the excavated areas to the elevation of the finished subgrade as specified hereinbefore under "Excavation." Additional excavation so ordered by the Engineer will be considered a change in the work and will be paid for in accordance with Article 2 of the Agreement.

Disposal of Excess and Unsuitable Excavated Materials. Excess excavated materials and excavated materials not suitable for use in backfilling the work shall be disposed of off the site at the Contractor's expense. The Contractor shall make his own arrangements for obtaining disposal areas. Proposed haul routes between the site and disposal areas shall be submitted by the Contractor to the Owner for their approval prior to commencing this work.

The Contractor shall take every precaution to prevent spillage of materials being hauled in public streets. It shall be the responsibility of the Contractor to immediately clean up any spillage which may accidentally occur.

Backfilling Around Structures. As soon as practicable after concrete structures have set, forms and debris have been removed and the surfaces of the concrete pointed up, the excavated area around structures shall be backfilled up to the specified grade with granular material free from boulders, stones, rocks, trash, debris and frozen lumps. All backfill shall be placed in layers not to exceed 12-inches in depth and shall be compacted to 95% maximum density.

At all points where pipework, plumbing lines or other similar work is to be constructed within an area which has been backfilled, such area shall be backfilled to the final ground level, thoroughly compacted and allowed to settle before other construction work goes ahead.

Soil Maximum Density. The maximum density of soil referred to in these specifications shall be determined by the ASTM D698 (Standard Proctor) Test.

Protection Against Erosion. The Contractor shall take all necessary precautions to prevent soil erosion of areas disturbed by the construction and prevent eroded materials from entering any sewers or natural water course. The Contractor shall provide temporary slope protection, temporary dikes, etc., as required.

SHEETING, BRACING AND SHORING

Placing Sheeting, Bracing and Shoring. Where required to properly support the surfaces of excavation, to protect the construction work, adjacent work, or workmen, sheeting, bracing and shoring shall be provided. If the Engineer is of the opinion that at any point sufficient or proper supports have not been provided, he may order additional supports at the expense of the Contractor, but neither the placing of such additional supports by the order of the Engineer nor the failure of the Engineer to order such additional supports placed shall release the Contractor from his responsibility for the sufficiency of such supports and the integrity of the work. In the removing of sheeting and bracing after the construction has been completed, special care shall be taken to prevent any caving of the sides of excavation and injury to the completed work or to adjacent property.

Sheeting Left In Place. Sheeting, bracing, and shoring shall not be left in place after completion of the work except as noted on the Drawings or as required by the Engineer. Where required to protect the work, adjacent structures or property, sheeting, bracing and shoring shall be left in place, but shall be cut off or left not less than two feet below the established surface grade.

DEWATERING AND DRAINAGE OF EXCAVATION

Water which may accumulate or groundwater which may be encountered in excavations shall be removed by well points, pumping, or other acceptable method. The excavations shall be kept dry until exterior walls have been completed and until the structures have been backfilled. Drainage ditches shall not be placed within the area to be occupied by any structure except where permitted by the Engineer. When such ditches are placed beneath the structures they shall be backfilled with Class C concrete as hereinafter specified. Drainage from excavation shall be disposed of in such a manner as will not cause injury to property or to the work completed or injury or inconvenience to the public.

Discharge water from dewatering methods shall be sediment free or be discharged through an Engineer approved sediment entrapment basin.

FINAL GRADING

After all structures and trenches are backfilled the site area shall be graded to the contours shown on the Drawings, minus four inches. The placing of 4-inches of topsoil and finish grading shall be done under Section 7 - Site Improvements and Restoration Work. Under this work areas to be graded shall be trimmed and all irregularities made smooth to accurate lines and grades established by the Engineer with 0.1 foot allowable tolerance above or below. Backslopes and fill slopes shall be finished to the average neat line slopes shown on the Drawings with no variations therefrom at any point more than 0.1 ft. measured at right angles to the slope.

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3. CONCRETE

GENERAL

SCOPE OF WORK

This work shall be subject to the conditions of the General Requirements and shall include the furnishing of the labor, materials, equipment, accessories, tools and services for the concrete work as shown on the Contract Drawings and/or as herein required.

WORK INCLUDED

This work includes the following subsections:

Cast-In-Place

Standard Concrete Specification

SAMPLES

When so directed by the Engineer, a representative sample of the material proposed for approval shall be submitted.

SHOP DRAWINGS

As prescribed in the General Requirements, complete details and erection drawings shall be furnished.

Shop Drawings shall show setting plan, reinforcing and details. Precast units shall be identified by a standard mark to be listed in the Schedule shown on the manufacturer's erection drawings and placed legibly on each unit at the time of manufacture. Specific work should be seen for any added requirements.

GUARANTEES

As prescribed under the General Requirements, guarantees covering the concrete work shall be furnished.

CAST-IN-PLACE CONCRETE

SCOPE OF WORK

Cast-in-place concrete shall be proportioned, mixed, placed, finished and cured in accordance with the recommendations of the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete, as adapted to suit the requirements of this work. The Adapted Standard Specification is appended hereto and as an integral part of this Specification.

WORK INCLUDED

Cast-in-place concrete work with accessory items.

All reinforced structural concrete.

All reinforced and unreinforced concrete foundations for equipment items and concrete piers for the support of pipe work, valves and gates, equipment and related accessories.

Grouting of baseplates and bearing plates.

Setting all sleeves, castings, face plates, flume liners, troughs and anchor bolts and grouting equipment bases furnished under other Sections/Divisions of the work or by the Owner excluding work under the Sections on Pipe Work, Plumbing, and HVAC, and Electrical.

WORK NOT INCLUDED

Concrete for encasement of pipes or conduit furnished and installed under Pipe Work, Plumbing, and HVAC, and Electrical sections.

Setting sleeves, castings and anchor bolts and grouting bases for items furnished and installed under Pipe Work; Plumbing, Process Piping and HVAC; and Electrical sections.

RELATED WORK BY OTHERS

Subsection	3 - Precast Concrete
Section	7 - Waterproofing and dampproofing concrete walls, where called for.

PRODUCTS

CONCRETE

Classes. The locations of the several classes of concrete, A, B and C, which shall be used in this work are as follows:

Class A	Columns, beams, walls, slabs and pavements laid on the ground.
Class B	Mud Mats
Class C	Fill under structures, encasement for piping below or adjacent to structures and encasement for floor drains, sewer inlets and similar items.

All Class A concrete shall be air entrained.

MISCELLANEOUS MATERIALS
Materials shall be equal to the following. Substitute materials proposed shall be submitted and approved by the Engineer.

Manufacturer	Item	Trade Name
Sonneborne Bldg. Products, Inc.	Sealer	Son-No-Mar
Toch Brothers, Inc.	Sealer	RIW Resistox
Sonneborn Bldg. Products, Inc.	Hardner	Lapidolith
Toch Brothers, Inc.	Hardner	RIW Flintox
Tuscon Division	Bonding Agent	Bond Coat No. 384
Standard Dry Wall Products	Bonding Agent	Thorobond
MAMECO International	Exp. Joint Sealant	Vulkem 45 or 230
Williams Prod. Co.	Exp. Joint Sealant	DYNASEAL W-100
W. R. Grace	Ex. Joint Filler	Semi-Rigid PVC Foam
U. S. Grout	Grout	Five Star
Master Builders	Grout	Embeco 636
Standard Dry Wall Products	Concrete Finish	Thoroseal
Anti-Hydro Waterproofing Co.	Concrete Finish	Hausling System

EXECUTION

FINISHES
Floor finishes shall be adjustable so that the floor will have a 1/8-inch per foot slope to floor drainage systems.

The locations of the several types of finish which shall be used in this work are as follows:

Exposed. Exposed concrete surfaces, except floors, shall be finished as set forth in the paragraph "Finish of Exposed Surfaces", in the Adapted Standard Specifications for Concrete. Exterior walls shall be finished down to a point one foot below finished grade. Interior surfaces of tanks shall be finished down to a point one foot below the water line. Exposed concrete top surface of retention basins shall be included.

Painted. Concrete surfaces of walls and ceilings, that are specified to be field painted under Section 9, shall not be finished as set forth in paragraph "Finish of Exposed Surfaces", in the Adapted Standard Specification for Concrete.

Top Course. Concrete floors with a two-inch drop, as shown on the Contract Drawings.

Monolithic. Concrete slabs where no drop is indicated.

Hardened. Floor finish for monolithic and top course finish concrete floors (except those with finishes applied under Section 6, "Finishes"), slabs and walkways, except tank bottoms, flume floors, concrete slabs covered by earth, sidewalks and roadways.

REPAIR OF CRACKS AND LEAKS IN NEW WORK
Concrete surfaces having cracks through which visible leakage occurs shall be repaired and made watertight under this work. Repair of cracks shall be done by chipping out, applying a bonding agent and patching to within 1/8-inch of the finish surface with a fast-setting, nonshrink patching mortar approved by the Engineer, then covering it with a brush waterproof finish as hereinafter specified under "Concrete Finish".

Cracks of more than ordinary width and/or depth, as determined by the Engineer, shall be caulked with lead wood prior to receiving the treatment specified above.

CUTTING OPENINGS IN AND REMOVAL OF EXISTING CONCRETE
Openings shall be cut in existing concrete where shown and required by the work. They shall be of sufficient size to permit the ready and easy construction of related work. After other work has been completed, all resulting spaces between new work and old concrete shall be completely filled with cement mortar and finished smooth.

Where shown or required, existing concrete shall be removed. Edges of concrete remaining in place and exposed to view in the finished structure shall be neatly finished with cement mortar.

Cutting of existing concrete shall be done in a workmanlike manner without injury to remaining portions of the structures.

BONDING NEW AND OLD CONCRETE
Unless otherwise noted, all surfaces of existing concrete against which new concrete will be placed shall be given a heavy brush coat of epoxy bond coat or resin-emulsion bonding agent. The manufacturer's directions shall be followed.

EXPANSION BOLTS

Unless otherwise noted, expansion bolts and accessories shall be galvanized and shall have concrete embedment depth and rated holding power not less than the following:

Bolt Diameter				
1/2"	5/8"	3/4"	7/8"	1"
Concrete Embedment Depth				
4"	4"	4"	6"	7"
Ultimate Pullout Strength in 3500 psi Concrete				
5000 lb	8500 lb	13,500 lb	16,000 lb	19,000 lb

EXPANSION JOINTS

Construct expansion joints in the concrete floors and walls where shown on the Drawings, using expansion joint filler and sealant as detailed.

GROUTING

Furnish all materials and perform all operations in connection with the grouting of column baseplates, bearing plates and equipment bases.

TYPICAL DETAILS

See the typical concrete details as shown on the Drawings.

ADAPTED STANDARD SPECIFICATIONS FOR CONCRETE AND REINFORCED CONCRETE

These specifications provide for the manufacture of concrete meeting specified strength requirements to be proportioned from available materials to produce high-grade concrete efficiently and economically.

To this end, it is required that the concrete quality be controlled by frequent compression tests, as specified, and that the materials be of known quality, which have been or shall be tested and found to meet the specifications. It is further required that uniformity of quality of materials be maintained throughout the work, by additional tests if necessary, in order that the concrete strength requirements be assured.

TESTS

In general, if acceptable test records of the materials to be furnished are available, no further material tests are required, but if such data are not available or if the quality or uniformity of quality is in question, then the Contractor shall furnish the required tests.

Testing and sampling of cement, aggregates and concrete shall conform to the requirements of the appropriate current standard ASTM Specification as follows:

Portland cement and high-early-strength cement	C-150
Concrete aggregates	C-33
Test for compressive strength of concrete	C-39
Method of securing and testing specimen of hardened concrete from structures	C-42
Test for air content of freshly-mixed concrete	C-173

MATERIALS

Cement. In general, portland cement conforming to the requirements of ASTM Specification C-150, Type I or IA shall be used except that Type III or IIIA shall be used where high-early-strength is required.

Adequate equipment for measuring the air content of freshly mixed concrete shall be furnished on the site of the work at all times.

All cement used for armored concrete floor finish shall be acid-proof.

Admixture. In general, concrete plasticity is secured by the selection of aggregates and in the proportioning of ingredients. Where it can be shown, to the satisfaction of the Engineer, that plasticity cannot be secured economically in this manner, consideration will be given to the use of an admixture, in which case samples shall be submitted together with full particulars.

Water. Water for concrete shall be clean and free from injurious amounts of oil, acid, alkali, salt, organic matter or other deleterious substances.

Fine Aggregate. Fine aggregate shall consist of natural sand or sand prepared from the product obtained by crushing stone or gravel.

Grading. Fine aggregate shall be graded from coarse to fine within the following limits:

SIEVE SIZE	TOTAL PASSING (Percentage by Weight)
3/8-inch	100
No. 4	95-100
No. 8	65-95
No. 16	35-75
No. 30	20-55
No. 50	10-30
No. 100	0-10
Loss by Washing	not more than 3
Fineness Modulus	2.60-3.35

For the purpose of controlling the grading of fine aggregate from any one source, a preliminary sample shall be submitted for fineness modulus determination prior to actual deliveries. This sample shall be representative of the material which it is proposed to furnish. Any shipment of fine aggregate made during the progress of the work which shows a variation in fineness modulus greater than 0.2 from the fineness modulus of the preliminary sample shall be rejected unless suitable adjustments acceptable to the Engineer are made in the concrete proportions to compensate for the difference in grading.

Deleterious Substances. Deleterious substances shall not be present in excess of the following amounts:

Description	Percentages By Weight
Friable particles	1
Coal and Lignite	1/2
Material finer than No. 200 sieve	3

Organic Impurities. The fine aggregate, when tested in accordance with the method of test for organic impurities, shall show a color no darker than the Plate 3 (light brown) unless the material complies with the mortar-strength test specified below.

Mortar Strength. Mortar specimens made with the fine aggregate, when subject to the Mortar Tensile Strength test, shall develop a tensile strength of at least 100 percent of the strength developed in the same time by a mortar prepared in the same manner with the same cement and Ottawa sand.

Soundness (a). The fine aggregate, when subjected to five cycles of the magnesium-sulphate soundness test, shall have an average weight loss of not more than sixteen percent. (b) Fine aggregate failing to meet the requirements of (a) above may be accepted, provided it is shown by evidence satisfactory to the Engineer that comparable concrete, made from similar aggregate from the same source, has been exposed to natural weathering for a period of at least 5 years without appreciable disintegration. (c) The requirements for soundness given in (a) and (b) above may be waived in the case of aggregate for use in structures or portions of structures not exposed to weathering.

Coarse Aggregate. Coarse aggregate shall consist of crushed stone or gravel of maximum sizes as follows:

Location	Maximum Size In Inches
Supported slabs, beams and columns	1
Foundation slabs, walls and pavements	1½

Grading. Coarse aggregate of the sizes designated shall conform to those shown in Table A.

Deleterious Substances. Deleterious substances shall not be present in excess of the amounts shown in Table B.

Soundness. (a) The coarse aggregate, when subjected to five cycles of the magnesium-sulphate soundness test, shall show an average weight loss of not more than that shown on Table B. (b) Coarse aggregate failing to meet the requirements of (a) above may be accepted, provided it is shown by evidence satisfactory to the Engineer that concrete of comparable properties made from similar aggregate from the same source, has been exposed to natural weathering for a period of at least five years without appreciable desintegration.

Abrasion. (a) The coarse aggregate, when subjected to an abrasion test, shall have a loss of not more than 36 percent. (b) Coarse aggregate having an abrasion loss greater than 36 percent may be used, provided the aggregate produces satisfactory strength in concrete of the proportion selected for the work.

Incrusted Particles. Coarse aggregate shall not contain more than 10 percent of particles which are incrusted for more than one-third of their surface area. At least 60 percent of the material shall be entirely free from incrustation.

Bar and Mat Reinforcement. Metal reinforcement shall be deformed steel bars or cold-drawn steel wire, or fabricated forms of these materials, as required by the Drawings or the specifications, or both. These materials shall conform in quality to the requirements of the appropriate current standard ASTM Specifications as follows:

TABLE A: Amounts of Coarse Aggregate Passing Laboratory Sieves Having Square Openings; Percentages by Weight

Designated Sizes	2½-inch	2-inch	1½-inch	1-inch	¾-inch	½-inch	3/8-inch	No. 4
1-in. to No. 4			100	95-100		30-60		0-8
1½-in. to No. 4		100	95-100		35-70		10-30	0-5

TABLE B: Maximum Allowable Amounts of Deleterious Substances in Coarse Aggregate; Percentages by Weight

Description	For Concrete Structures Exposed to Weathering	For Concrete Structures Not Exposed to Weathering
(1) Soft Particles	2	2.5
(2) Chert		
(3) Hard absorbent particles		
The sum of (1), (2), (3) percentages shall not exceed:	4	9
Limits to thin or elongated pieces	15	15
Abrasion test (Standard Los Angeles)	36	36
Soundness, crushed rock	9	12
Incrusted particles	10*	10*
Loss by Washing	1	1

*Incrusted for more than 1/3 of its surface area.

Material	ASTM
Deformed billet steel bars	A-615 (Grade 60)
Rail steel deformed bars	A-616 (Grade 60)
Axle steel deformed bars	A-617 (Grade 60)
Fabricated steel bars or rod mats	A-184
Welded steel wire fabric	A-185
Welded deformed steel wire fabric	A-497

All necessary chairs, bolsters and other accessories to properly support and hold the reinforcing steel shall conform to Concrete Reinforcing Steel Institute Standards and shall be provided and installed.

On all exposed concrete surfaces supports for reinforcement bars or wires shall be plastic-protected at points of contact with forms.

The plastic shall have a thickness of not less than 3/32 inch, with an average thickness of 1/8 inch. The plastic shall extend upward on the wire to a point at least 1/2 inch above the forms. The plastic shall not chip, peel, crack or deform under ordinary job conditions and temperatures and shall be resistant to sandblasting.

At the option of the manufacture, the plastic protection may be applied by any of the following: by a dipping operation, by the addition of premolded plastic tips to the legs of the support or by molding legs to the top wire.

Proportioning

Concrete Quality. It is the intent of this specification to secure, for every part of the work, concrete of homogeneous structure which, when hardened, will have the required strength and resistance to weathering. To this end, the limiting strength and water contents shown in Table C are based on the use of normal portland cement, aggregates and water which meet the requirements for these materials as hereinbefore specified.

The strengths shall be determined in accordance with the requirements hereinafter specified under "Field Tests." The maximum allowable net water content is the total water in the mixture at the time of mixing, including the water held by the aggregates.

Slump. The slump used in the mix design shall not exceed the values listed in Table C. After approval of the design mix, the slump used for the design mix shall govern and replace values in Table C.

Determination of Proportions. (a) Laboratory trial batches of concrete, made with the cement and aggregate to be used on the work, shall be used as the basis for selecting concrete proportions. Compressive-strength tests shall be made on specimens prepared in accordance with "Method of Making and Curing Test Specimens in the Laboratory" (ASTM C 192). A curve shall be established showing the relationship between water-cement ratio (or cement content) and compressive strength. The curve shall be based on at least three points representing batches which produce strengths above and below that required. Each point shall represent the average of at least three specimens tested at 28 days. A similar second curve shall also be established for specimens tested at 7 days. The maximum permissible water-cement ratio (or minimum cement content) for the concrete to be used in the structure shall be that shown by the curve to produce the average strength required in Table C.

In lieu of the above, where the concrete production facility has a record based on at least 30 consecutive strength tests representing similar materials and conditions to those expected, the selection of concrete proportions may be made in accordance with the strength requirements in Table C.

At least 35 days prior to the beginning of concrete work the Contractor shall submit, for approval, samples of the materials he proposes to use. Prior to the beginning of work he shall also submit a statement of the proportions proposed for the concrete mixture. This shall be accompanied by a report from an approved testing laboratory or inspection service showing the results of the strength tests from which the proposed proportion was selected.

(b) The Engineer shall have the right to require check test of concrete using the same materials and to order such changes as may be necessary to meet the requirements of the specifications.

(c) The ratio between the 7-day and 28-day strengths established by the preliminary tests shall be used to determine the 7-day strengths necessary to satisfy the 28-day strength requirements of Table C. This ratio shall be modified as the work progresses, as may be indicated by the results of tests made in accordance with the field tests as hereinafter specified.

TABLE C: Required Proportions of Cement and Water to Produce Strengths and Consistencies in Three Classes of Concrete

Class	Min. Allowable Compressive Strength at 28 days(psi)	Min. Average Compressive Strength at 28 Days (psi)	Max. Allowable New Water Content per sack of cement (gal.)	Consistency Range of Slump (in.)	Air Content (Percent by Volume)
A	4000	4600	5½	5-3	4-6
B	3000	3600	7¼	5-3	
C	2000	2600	8½	6-3	

Workability of Concrete. The concrete shall be of such consistency and composition that it can be worked readily into the corners and angles of the forms and around the reinforcement without permitting the materials to segregate or free water to collect on the surface.

Subject to the limiting requirements of Table C, the Contractor shall adjust the proportions of cement and aggregate as may be necessary to produce a mixture which will be easily placeable at all times, due consideration being given to the methods of placing and compacting used on the work.

Changes in Consistency for Mechanical Vibration. When high-frequency mechanical vibration is used for compacting concrete, the limiting consistencies in Table C may be modified, subject to the approval of the Engineer. The proportions and consistencies, however, shall be such that with the vibratory equipment in use the full requirement given immediately above shall be satisfied.

Changes in Proportions or Materials by the Engineer. If, during the progress of the work, it is found impossible to secure concrete of the required workability and strength with the materials being furnished by the Contractor, the Engineer may order such changes in proportions or materials, or both, as may be necessary to secure the desired properties, subject to the limiting requirements shown in Table C. Any changes so ordered shall be made at the Contractor's expense, and no extra compensation will be allowed by reason of such changes.

Changes in Materials by the Contractor. If, during the progress of the work, the Contractor desires to use materials other than those originally approved, or if the materials from the sources originally approved change in characteristics, he shall submit, for approval, evidence satisfactory to the Engineer that the new combination of materials will produce concrete meeting the requirements shown in Table C and will not bring about objectionable changes in the color or appearance of the structures.

Changes in Requirements. Regardless of the limitations of Table C, at any time during the progress of the work, the Owner shall have the right to make such changes in the materials or proportions, or both, as he may consider necessary to meet the requirements of the structures. In such case, the Contractor shall be compensated in accordance with the terms of the contract for the additional cost of materials and additional handling and placing costs, if any, entailed by changed materials or mixtures, or both, which are not covered by the specification requirements shown in Table C for the respective proportions of the work involved.

Concrete Made with High-Early-Strength Portland Cement. When high-early-strength portland cement is used in lieu of normal portland cement, the requirements given in Table C shall apply, except that the "Minimum allowable strength at 28 days" specified for normal portland cement shall be the minimum allowable strength at 7 days. The ages at time of test specified under "Determination of Proportion" shall be 3 days and 7 days in lieu of 7-day and 28-day ages specified for normal portland cement.

Measurement of Materials. Materials shall be measured by weighing, except as otherwise specified or where other methods are specifically authorized by the Engineer. The apparatus provided for weighing the aggregates and cement shall be suitably designed and constructed for this purpose. Each size of aggregate and the cement shall be weighed separately. The accuracy of all weighing devices shall be such that successive quantities can be measured to within 1 percent of the desired amount. Cement in standard packages (sack) need not be

weighed. The mixing water shall be measured by volume or by weight. The water measuring device shall be susceptible of control accurate to 0.5 percent of the capacity of the tank. All measuring devices shall be subject to approval.

MIXING

Equipment. The mixing equipment shall be capable of combining the aggregate, cement, and water, within the specified time, into a thoroughly mixed and uniform mas, and of discharging the mixture without segregation.

Machine Mixing (at Site or at Central Mixing Plant). Unless otherwise authorized by the Engineer, the mixing of concrete shall be done in a batch mixer of approved type which will ensure uniform distribution of the material throughout the mass. The equipment at the mixing plant shall be so constructed that all materials (including the water) entering the drum can be accurately proportioned and be under control. The entire batch shall be discharged before recharging. The mixer shall be operated within the limits of capacity and speed of rotation designated by the manufacturer. Except as qualified under "Partial Mixing at the Central Plant", mixing of each batch shall be continued for the periods indicated below. The mixing periods shall be measured from the time all cement and aggregates are in the drum. The batch shall be so charged into the mixer that some water will enter in advance of cement and aggregate, and all water shall be in the drum before one-fourth of the mixing time has elapsed.

Mixing Time:

1. For mixers of a capacity of 1 cubic yard or less, 1-1/2 minutes.
2. For mixers of capacities larger than 1 cubic yard, mixing time of 1-1/2 minutes shall be increased 15 seconds for each additional cubic yard capacity or fraction thereof.

Truck Mixing. Truck mixers, unless otherwise authorized by the Engineer, shall be of the revolving-drum type, water-tight, and so constructed that the concrete can be mixed to ensure a uniform distribution of materials throughout the mass. All solid materials for the concrete shall be accurately measured as specified under "Measurement of Materials" and charged into the drum at the proportioning plant. Except as subsequently provided, the truck mixer shall be equipped with a tank for carrying mixing water. Only the prescribed amount of water shall be placed in the tank unless the tank is equipped with a device by which the quantity of water added can be readily verified. The mixing water may be added directly to the batch, in which case a tank shall not be required. Truck mixers shall have a drum turn counter to indicate the total revolutions on the drum. It may also be required to be provided with a means by which the mixing time can be readily verified by the Engineer. The maximum size of batch in truck mixers shall be in accordance with the specified rating.

The mixing operation shall begin within 30 minutes after the cement has been intermingled with the aggregates and immediately after the addition of mixing water. Each batch shall be mixed not fewer than 70 nor more than 120 revolutions of the drum at a rate of rotation designated by the manufacturer.

Partial Mixing at the Central Plant. When a truck mixer or an agitator provided with adequate mixing blades is used for transportion, the mixing time at the stationary machine mixer may be reduced to 30 seconds and the mixing may be completed in a truck mixer or agitator. The mixing time in the truck mixer or agitator equipped with adequate mixing blades shall be as specified for "Truck Mixing." The maximum volume of mixed concrete transported in an agitator shall be in accordance with the specified rating.

Time of Hauling Ready-Mixed Concrete. Concrete transported in a truck mixer, agitator or other transportation device shall be discharged at the job within 1-1/2 hours after the cement has been added to the water or the aggregates.

Hand Mixing. When hand mixing is authorized it shall be done on a watertight platform and in such a manner as to ensure a uniform distribution of the materials throughout the mass. Mixing shall be continued until a homogeneous mixture of the required consistency is obtained.

Retempering. The retempering of concrete or mortar which has partially hardened, that is, remixing with or without additional cement, aggregate, or water, will not be permitted.

CURING OF CONCRETE

(a) All concrete, except as noted under (c) below, placed under these specifications shall be so protected that the temperature at the surface will not fall below 50°F and that there will be no loss of moisture from the surface for the periods indicated below.

1. When normal portland cement is used; 7 days.
2. When high-early-strength portland cement is used; 3 days.

(b) The Contractor shall submit for the approval of the Engineer the methods he proposes to use for protecting the concrete against low temperatures.

(c) The requirements in (a) and (b) above concerning the temperature at the surface are intended to apply to the placing of concrete in those seasons of the year when, or

in such places where, the possibility of freezing or continued low temperatures below 40°F, is a rarity. In any case, however, concrete must be protected from freezing temperatures at any time during the first 72 hours when normal portland cement is used, or 24 hours when high-early-strength portland cement is used.

(d) Protection against loss of moisture from the surface of the concrete shall be accomplished by keeping the surface continuously wet. One of the following methods shall be used.

(1) Protecting surfaces of slabs by ponding.
(2) Covering with burlap or cottom mats kept continuously wet.
(3) Covering with two-ply kraft paper with asphalt membrane or with medium-weight, asphalt impregnated, waterproof paper.
(4) Covering with a one-inch layer of thoroughly wet sand, earth or sawdust, kept continuously wet.
(5) Continuous sprinkling of the exposed surfaces.
(6) Application of curing compound if approved by the Engineer. Curing compound shall not contain any ingredients which might stain through or otherwise injure the concrete or prevent a good bond for subsequent coatings or finishes.

TESTING

Field Tests. During the progress of construction and at the direction of the Engineer, the Contractor shall have tests made to determine that the concrete being produced complies with the "concrete quality" specified. The Engineer will assist in the preparation of test cylinders. The Contractor shall provide concrete for test purposes and he shall at all times so handle and store test specimens as to protect them from damage. Specimens shall be adequately packed and shipped in substantial packages which will prevent damage during transit. The Contractor shall bear all expenses of shipment to and testing of test specimens by an approved testing laboratory.

Test Pieces. Samples for strength tests of each class of concrete shall be taken not less than once a day nor less than once for each 150 cubic yard of concrete or for each 500 square feet of surface area placed. Each sample shall consist of three cylinders. In special cases this normal number of samples may be exceeded when, in the opinion of the Engineer, such additional tests are necessary. The Contractor, however, shall not be required to furnish for such additional tests more than two cubic feet of concrete from each 100 cubic yards of concrete being placed.

Sampling and Curing of Test Pieces. Samples of concrete for test specimens shall be taken at the mixer, or in the case of ready-mixed concrete, from the transportation vehicle during discharge. When, in the opinion of the Engineer, it is desirable to make samples elsewhere, they shall be taken as directed by him. The test specimens shall be molded immediately after the samples are taken, placed in a protected spot and kept under moist curing conditions at approximately 70°F for 24 hours, whereupon they shall be removed to the testing laboratory. In the laboratory they shall be kept under standard moist curing conditions at 70°F (+ or - 5°F) until the time of the test, and then they shall be tested in the damp condition.

Age. One cylinder shall be tested when it is 7 days old; two cylinders shall be tested when they are 28 days old.

Compression Tests. For compression tests, the size of the cylinder and the manner of molding, capping and testing shall be in accordance with ASTM Specification C-39.

Enforcement of Strength Requirements

Failure to Meet Requirements. Should the strengths shown by the test specimens made and tested in accordance with the field test provisions fall below the values given in Table C, as interpreted by the 7-day/28-day ratio established by the preliminary tests, the Engineer shall have the right to require changes in proportions as outlined under "Changes in Proportions or Materials by the Engineer", which shall apply on the remainder of the work. Furthermore, the Engineer shall have the right to require additional curing, as hereinafter specified, on those portions of the structure represented by the test specimens which failed. In the event that such additional curing does not give the strength required, the Engineer shall have the right to require strengthening or replacement of those portions of the structure which fail to develop the required strength.

Definition of Strength. The strength level of the concrete will be considered satisfactory the averages of all sets of three consecutive strength test results equal or exceed the required compressive strength and no individual strength test result falls below the required compressive strength by more than 500 psi.

Additional Curing. When additional curing of portions of the structure is ordered by the Engineer, due to failure to meet requirements, it shall be done at the Contractor's expense, and no claim for extra compensation for such additional curing will be allowed. Such additional curing shall consist of an extension of the periods of protection as may, in the judgment of the Engineer, be necessary. In no case, however, shall the Contractor be required to provide such additional curing beyond a total of 21 days, except when the average strengths of specimens, representing concrete placed on any three consecutive samples, fall below 80 percent of the value specified in Table C. In this case, curing shall be

continued until cores drilled from portions of the structure involved show an average strength equal to that specified in Table C. Cores for this purpose shall have a diameter of approximately three times the maximum size of aggregate and shall be secured, capped and tested in accordance with ASTM Specification C-42.

Forms

General. Forms shall conform to the shape, lines, grades and dimensions of the concrete as called for on the drawings. Forms for exposed surfaces of concrete walls or ceilings shall be lined with: (1) tongue-and-grooved lumber, dressed to uniform thickness and free from loose knots or other defects; (2) plywood; (3) tempered hardboard; (4) an approved metal lining; or (5) steel forms. Forms for exposed surfaces must be built and maintained in excellent condition. All such forms, each time before being used, must be cleaned of cement and dirt and shall have a substantial coat of acceptable lubricating material applied to them to prevent the cement from adhering. Form treatment must be approved by the Engineer and shall not contain any ingredients which might stain through or otherwise injure the concrete or prevent a good bond for subsequent coatings or finishes. Joints in forms shall be horizontal or vertical where appearance of the finished surface is of importance. For unexposed surfaces and rough work, undressed lumber may be used. Lumber, plywood or tempered hardboard once used in forms shall have nails withdrawn before being used again.

Design. (a) Forms shall be sufficiently tight to prevent leakage of mortar. They shall be properly braced or tied together so as to maintain the desired position and shape during and after placing concrete. In the case of very long spans where no intermediate supports are possible, the probable deflection in the forms due to the weight of the fresh concrete shall be taken into account so that the finished members shall conform accurately to the desired line and grade. If adequate foundation for shores cannot be secured, trussed supports shall be provided.

(b) Bolts and rods shall preferably be used for internal ties; they shall be so arranged that when the forms are removed no metal shall be within 1 inch of any surface. Shores supporting successive stories shall be placed directly over those below, or so designed and placed that the load will be transmitted directly to them.

Joist Forms. Joist forms shall be of metal and shall be of sufficient strength to carry without undue deflection the weight of concrete supported thereon and also any ordinary loads during the placing of the steel and concrete. Forms shall at all times be clean and sufficiently straight to provide joists of the widths and depths shown on the drawings.

Joist forms shall be in standard widths, depths and tapers as approved by the Division of Simplified Practice of the Department of Commerce through their Simplified Recommendation R-87.

Moldings. Unles otherwise specified, a 1-inch minimum chamfer shall be placed in the angles of forms to round or bevel the edges of the concrete. This includes both vertical and horizontal edges.

Inspection. Temporary openings shall be provided at the bases of column and wall forms, and at other points where necessary, or as directed by the Engineer. To facilitate cleaning and inspection immediately before depositing concrete.

Openings. Where required by the piping or by equipment erection, or by direction of the Engineer, openings shall be left in concrete walls or floors in which pipes or castings will later be placed or equipment will later be moved or placed. Forms for such openings shall be neatly made and shall be so constructed as to leave an ample keyway with water stop, where required, around the entire opening, midway between the two faces of the wall or floor. Wherever steel reinforcement is removed or omitted on account of openings in forms, extra steel bars shall be provided for the purpose of dowels as specified hereinafter for splice bars under "Splicing of Reinforcement".

After the pipes, castings, or equipment have been placed and aligned in final position, the openings in the concrete shall be closed up with concrete in such a manner as to leave the finished wall or floor surface smooth and of neat appearance.

Openings for form removal or other construction purposes will not be permitted wherever manholes or grating openings are available for use during the construction period.

Form Removal. The removal of forms shall not be begun until the concrete has attained the necessary strength to support its own weight and any construction live loads. Vertical forms shall be left in place until the concrete has sufficiently set to sustain its own weight plus any construction loads likely to come upon it. Forms other than vertical forms shall be left in place until the concrete has hardened sufficiently to carry the full load which it must sustain, unless removed in sections and each section of the structure immediately reshored. The minimum period that forms shall remain in place shall be as shown in Table D.

Depositing Concrete

General. (a) Before placement of concrete is begun, hardened concrete and foreign materials shall be removed from the inner surfaces of the mixing and conveying equipment.

(b) Before concrete is deposited, debris shall be removed

from the space to be occupied by the concrete. Reinforcement shall be thoroughly secured in position and approval of the Engineer obtained before concrete is placed.

TABLE D: Minimum Periods that Forms are to Remain in Place

Part of Structure	Average Temperature During Period		
	40° – 50°F	50° – 60°F	Above 60°F
Walls, columns and sides of beams	88 hours	64 hours	40 hours
Bottom forms for slabs and beams not reshored	12 days	9 days	7 days
Bottom forms for slabs and beams if reshored	7 days	5 days	4 days
Monolithic arches	88 hours	64 hours	40 hours

(c) Immediately prior to depositing concrete in walls, the bottom of the wall space shall be filled to a height of 2 to 4 inches with a grout mixture composed of one part Type I portland cement, one part fine aggregate and two parts coarse aggregate having a maximum size of 3/8 inch.

Removal of Water. Water shall be removed from the space to be occupied by the concrete before concrete is deposited, unless otherwise directed by the Engineer. Any flow of water into an excavation shall be diverted through proper side drains to a sump or be removed by other approved methods which will avoid washing the freshly deposited concrete. If directed by the Engineer, water vent pipes and drains shall be filled by grouting or other means after the concrete has thoroughly hardened.

Handling. (a) Concrete shall be handled from the mixer, or in the case of ready-mixed concrete, from the transporting vehicle, to the place of final deposit as rapidly as practicable by methods which will prevent the separation or loss of the ingredients. Under no circumstances shall concrete that has partially hardened be deposited in the work. Concrete shall be deposited in the forms as nearly as practicable in its final position to avoid rehandling. It shall be so deposited as to maintain, until the completion of the unit, a plastic surface approximately horizontal. Forms for walls or thin sections of considerable height shall be provided with openings or other devices that will permit the concrete to be placed in a manner that will prevent segregation and accumulation of hardened concrete on the forms or metal reinforcement above the level of the concrete.

(b) Concrete, regardless of the type of transporting vehicle, shall have, when deposited in the forms, the quality required.

Chuting. When concrete is conveyed by chutes, the equipment shall be of such size and design as to ensure a continuous flow in the chute. The chutes shall be of metal or be metal-lined, and the different portions shall have approximately the same slope. The slope shall not be less than one vertical to two horizontal and shall be such as to prevent segregation of the ingredients. The discharge end of the chute shall be provided with a baffle plate to prevent segregation. The chutes shall be so positioned that the concrete will not need to flow more than five feet horizontally. Concrete shall not be dropped from the end of a chute a distance greater than three times the horizontal thickness of the layer being deposited, with a maximum distance of five feet. Where the distance from the end of the chute to the surface of the concrete exceeds these distances, a spout shall be used and the lower end maintained as near to the surface of deposit as practicable. When the operation is intermittent, the chute shall discharge into a hopper. The chute shall be thoroughly cleaned before and after each run, and the debris and any water used shall be discharged outside the forms.

Compacting. (a) Concrete, during and immediately after depositing shall be thoroughly compacted by means of mechanical vibrators or other suitable tools approved by the Engineer.

The Concrete shall be thoroughly worked around the reinforcement and embedded fixtures and into the corners of the forms.

(b) Accumulations of water on the surface of the concrete due to water gain, segregation or other causes during placement and compacting, shall be prevented as far as possible by adjustments in the mixtures. Provision shall be made for the removal of such water as may accumulate so that under no circumstances will concrete be placed in such accumulations.

Depositing Continuously. Concrete shall be deposited

continuously or in layers in such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams and/or planes of weakness within the section. If a section cannot be placed continuously, construction joints may be located at locations as provided for on the drawings or approved by the Engineer. Such joints shall be made as specified under "Construction Joints".

Depositing in Cold Weather. Concrete, when deposited, shall have a temperature of not less than 50°F, nor more than 90°F. In freezing weather suitable means shall be provided for maintaining the concrete at the temperature and for the periods specified under "Curing of Concrete", or until the concrete has thoroughly hardened. Before the concrete is placed, the forms shall be free from frost and ice, and after the concrete is placed it shall be protected on all exposed sides by straw, tarpaulins or other means. The methods of heating the materials and protecting the concrete shall be approved by the Engineer. Salts, chemicals or other foreign materials shall not be mixed with the concrete for the purpose of preventing freezing. Concrete shall not be placed on frozen ground.

Bonding. Before depositing new concrete on or against concrete which has hardened, the hardened concrete shall be roughened as required by the Engineer, in a manner that will not leave loosened particles of aggregate or damaged concrete at the surface. It shall be thoroughly cleaned of foreign matter and laitance and saturated with water. To ensure an excess of mortar at the juncture of the hardened and the newly deposited concrete, the cleaned and saturated surfaces, including vertical and inclined surfaces, shall first be thoroughly covered with a coating of mortar or neat cement grout against which the new concrete shall be placed before the grout has attained its initial set.

Handling Metal Reinforcement

Cleaning. Metal reinforcement, before being positioned, shall be free from loose mill scale and rust scale and from coatings, including ice, that destroy or reduce the bond. When there is delay in depositing concrete, reinforcement shall be reinspected and cleaned when necessary.

Fabrication. Reinforcement shall be accurately formed to the dimensions indicated on the drawings. Bends of 135 degrees in stirrups and tie bars shall be bent around a pin having a diameter not less than four times the minimum thickness of the bar. Bends for other bars shall be made around a pin having a diameter not less than six times the minimum thickness, except for bars larger than 1 inch, in which case the bends shall be made around a pin of eight bar diameters. All bars shall be bent cold. No bars partially embedded in concrete shall be field bent, except as shown on the plans or permitted by the Engineer.

Straightening and Rebending. Metal reinforcement shall not be straightened or rebent in a manner that will injure the material. Bars with kinks or bends not shown on the drawings shall not be used. Heating of the reinforcement will be permitted only when the entire operation is approved by the Engineer.

Placing Reinforcement. Metal reinforcement shall be accurately placed and adequately secured in position by concrete or metal bar supports. All metal bar supports shall conform to the Concrete Reinforcing Steel Institute Standards. For all exposed concrete the plastic tip bar support, specified hereinbefore under "Bar and Mat Reinforcement", shall be used. The minimum clear distance between parallel bars, except in columns, shall be equal to the nominal diameter of the bars. In no case shall the clear distance between bars be less than 1 inch, nor less than one and one-third times the maximum size of the coarse aggregate. Where reinforcement in beams or girders is placed in two or more layers, the clear distance between layers shall be not less than 1 inch, and the bars in the upper layers shall be placed directly above those in the bottom layer.

Concrete Protection for Reinforcement. The reinforcement of footings and other principal structural members in which concrete is deposited against the ground shall have not less than 3 inches of concrete between it and the ground contact surface. Where the footing or other structural member is poured over a mud mat, the reinforcement shall have a clear distance of 2 inches above the surface of the mud mat.

The concrete protective covering for reinforcement in slabs not exposed to water, earth or weather shall be ¾-inch, and in slabs exposed to water, earth or weather shall be 2-inches. This applies to both top and bottom surfaces.

The concrete protective covering for principal reinforcement in beams, girders, columns and walls, both interior and exterior, shall be 2-inches.

The principal, or moment-carrying, reinforcement in walls and slabs shall in all cases be placed next to the forms, with the temperature steel placed at right angles to and in contact with the principal steel. However, for beams, girders and columns with stirrups or ties, the concrete protective coverings as given above shall apply to the principal steel reinforcement.

Splicing of Reinforcement. When it is necessary to splice reinforcement at points other than shown on the drawings, the character of the splice shall be determined by the Engineer. At splices, bars shall be lapped a distance as shown in the Schedule on the Standard Detail Drawing to ensure full bond development on the reinforcement.

Splices in adjacent bars shall be staggered. All bars shall be securely wired to the cross or tie bars.

Future Bonding. Exposed reinforcement intended for bonding with future extension shall be effectively protected from corrosion.

Construction Joints

Location of Joints (a) Columns. Joints in columns shall be made at the undersides of floor members and at floor levels. Haunches and column capitals shall be considered as part of and continuous with the floor or roof. At least two hours shall elapse after depositing concrete in columns or walls before depositing the concrete in the floor system.

(b) Floors. Construction joints in the floor system shall be located at or near the middle of the span in slabs, beams or girders unless a beam intersects a girder at this point, in which case the joint in the girder shall be offset a distance equal to twice the width of the beam, and provision, satisfactory to the Engineer, shall be made for shear by the use of inclined web reinforcement across the joint.

Construction joints shall not be made in roof slabs or domes unless indicated on the drawings.

Procedure in Forming Joints. The procedure specified for bonding new concrete to old shall be followed in the formation of all joints. The reinforcement shall continue through the joint and mechanical inserts with threaded studs will not be accepted as substitute for through dowels. For concrete without reinforcement, shearing strength shall be provided by means of a concrete key or dowel bars as the Engineer may direct.

Watertight Construction Joints.(a). Where a construction joint is required to resist water pressure, special care shall be taken in finishing the surface to which the succeeding concrete is to be bonded. The consistency of the concrete shall be carefully controlled so that it can be placed with a minimum of puddling with no free water showing. The surface shall be protected from loss of moisture and from mechanical injury. In applying the new concrete the procedure specified under bonding shall be followed.

(b) Vertical construction joints shall not be made in watertight construction unless shown on the plans or authorized by the Engineer.

(c) Where shown on the drawings or wherever construction joints are made in water-retaining walls or floors, including those of rooms next to earth, a steel cut-off strip or rubber or plastic waterstop shall be cast in the joints. Steel cut-off strips shall be free from rust scale and coatings and of the size and thickness shown on the drawings. Ends of strips shall be tightly welded together to ensure continuity of the cut-off. Rubber or plastic waterstops shall be of the types and sizes indicated on the drawings. Ends and junctions shall be vulcanized or cemented to ensure continuity.

Concrete Finishes

Surface Treatment After Removal of Forms. Immediately following the removal of forms, all form ties shall be cut off at a depth of at least 3/4-inch beneath the surface of the concrete. Any undesirable fins or other projections on the surface shall be carefully removed and offsets leveled. Tie holes and honeycombed, cracked, spalled or damaged areas shall be immediately repaired by chipping out, saturating with water and patching flush with a fast setting nonshrink patching mortar as approved by the Engineer. After the necessary repairs are made, the surface shall be finished with a wood float so as to be free from streaks, discolorations or other imperfections. Plastering will not be permitted. The use of a steel trowel to finish surfaces will likewise not be permitted.

Finish of Exposed Surfaces. All surfaces of walls, slabs, beams and columns that will be exposed to view in the completed work shall be finished in the following manner. All work set forth in the paragraph immediately above shall first be done. Oil marks and rust stains shall be removed by lightly sand blasting the surface. After the defects have been repaired as specified above, A coating of approximately 1/8 inch in thickness, as approved by the Engineer shall be applied as follows:

a. General. Contractor shall prepare a sample panel showing texture for approval. Unless otherwise noted on the Drawings color shall be standard gray. Application should be made by skilled workmen familiar with this type of work. Contractors shall consult with manufacturer's representatives as to application techniques.

The standard gray color of the brush and float waterproof finish shall be consistent. Therefore, the same batch number shall be used for individual concrete structures, for concrete structures that abut each other and for walls and ceilings of individual rooms.

b. Preparation of Surface. No application is to be made when the atmospheric temperature is below 40°F or expected to drop below 40°F within 24 hours after

application. Coating shall not be applied to frozen or frost-filled surfaces, and areas requiring heating prior to the application of the coating shall be continuously heated for a period to 72 hours prior to the start of any coating operation.

The surface to be coated must be clean, free of all laitance, dirt, dust, grease, form release treatments, efflorescence, curing compounds, paint and foreign material. All concrete appurtenances that extend above the level of the surface shall be removed. If the surface is hot or application is made during a hot day, cool the surface with clean water first. Allow at least one hour for the surface to dry. Do not make application while the surface is excessively damp. A section of surface being coated shall be worked in the shade and completed the day it is started.

c. Brush and Float Waterproofed Finish. A cement base coating shall be mixed using a solution of not less than 1 part acrylic polymer bonding agent and 3 parts of clean water. The solution of polymer and water shall be added to a commercial dry powder cement base waterproof material in sufficient quantity that the mixture shall have a consistency suitable for application by brush. Do not overwet the mix. Mix the material adequately and uniformly. Power mixing is recommended. When using power mixing, add the dry ingredients to the liquid. Apply a heavy brush coat of finish coating to the concrete surface at a rate of 2 pounds per square yard. The specially designed 10-inch or 14-inch brushes are recommended.

After the first coat has set, apply a second brush coat of finish coating at the same rate of 2 pounds per square yard. Use the polymer in the mixing water in the same proportions of 1 part polymer bonding agent to every 3 parts of mixing water. When the surface is set so it will not roll or lift, float the surface to uniform texture with a sponge float. Do not use water. Sufficient material must be applied to fill and seal all pores and voids. Leveling uneven surfaces will require more material per square yard.

d. Curing. Curing is not normally necessary. If application is made under extremely windy or hot conditions and too rapid drying occurs, surface curing by spraying with a fine mist of water is recommended for 2 to 6 hours after application. If color is used, do not cure until the next morning and then mist spray with clean water.

e. Repair of Damaged Areas. All damaged areas, including those discolored, spalled, cracked or non-uniform in texture, shall be repaired to the satisfaction of the Engineer.

Other Concrete Work

Equipment Foundations. Foundations shall be built to support all equipment to be installed unless shown otherwise on the drawings. These foundations have, in general, been shown on the plans, but the exact sizes and shapes will be fixed by the requirements of the equipment as actually purchased. Foundations shall be four to six inches larger than the metal bases of the equipment. Exterior vertical corners and horizontal edges shall be formed with moldings as hereinbefore specified. Vertical faces shall be rubbed with a carborundum brick. Structural floors under foundations shall be roughened when built to provide adequate bond. When shown, steel bar dowels shall be set in the structural floors for anchorage.

Sleeve inserts, anchor bolts and sole plates which are furnished with or required by the equipment, furnished under other sections of the work, shall be set in the foundations to the dimensions required by the equipment.

All equipment bases shall be grouted in place under this item. Areas shall be filled with a non-shrink grout equal to Five Star Grout, Master Builders Embeco 636 Grout, or equal. Minimum thickness shall be 1½ inches or as recommended by equipment manufacturer.

All concrete piers for the support of pipe work, valves and all other pipe fittings or accessories shall be included under this heading.

Concrete Curbs. Concrete curbs shall be provided wherever shown on the drawings. In general, curbs are required around open stair wells, floor openings and at edges of balconies. Curbs shall follow the details shown, with one-inch radius top edges. Coves are not required at the intersection with the structural floor, but will be built with the top-course floor finish or monolithic floor finish.

Building-In Work. All necessary ties, anchors, bolts, inserts, bucks, wood bricks, flashing, sleeves for pipe railings, conduits of every kind, steel sash, door frames, manhole steps, metal stair treads and other work shall be accurately set and securely held in concrete work in accordance with details shown on the drawings, approved shop drawings or standard practice. All necessary work of this nature required for equipment furnished under other contracts shall be performed under this contract. Sole plates furnished with or required by the equipment shall be set in the supporting slab to the dimensions required by the equipment. Grouting of the sole plates, if required, shall be done under this item.

Suitable sleeves shall be set in concrete for piping of every kind where such piping passes through concrete work. Such sleeves shall be set with due regard to their position in the final finish. Proper allowance shall be made in concrete work for ventilating ducts, flues and equipment of every sort. Recesses and depressions shall be left in floors where necessary for setting plumbing fixtures, and concrete reinforcement shall be placed so as to avoid interference with such equipment.

Conduits for electrical work and other services shall be set and shall be secured in such manner that they will not be displaced during the placing of the concrete nor damaged by the subsequent removal of forms. Care shall be taken that the surface finish of outlet boxes and other fixtures shall be in proper relation to the building finish.

Pipes or castings, as shown on the drawings, or as directed by the Engineer, to be set in concrete structures, shall be placed in the locations shown on the plans or as modified by equipment details. Special care shall be taken to place and keep them at the proper lines and grades. Concrete shall be placed only on one side of the pipe or casting until it flushes through and comes out on the other side, after which, placing of concrete shall be continued on both sides.

Where directed by the Engineer, openings shall be left in concrete walls or floors in which pipes or castings will later be placed. Forms for such openings shall be neatly made and be so constructed as to leave an ample keyway, with water stop where required, around the entire opening midway between the two faces of the wall or floor. After the pipes or castings have been placed and aligned in final position, openings in the concrete shall be closed up with concrete or non-shrink grout in such manner as to leave the finished wall or floor surface smooth and of neat appearance. Openings in tank walls and other areas containing liquid shall be filled with non-shrink grout. When metal aggregate is used, the grout shall be recessed 3/4 inch and plastered with a cement-sand mixture.

Where shown on the drawings, openings shall be cut in existing concrete walls or floors. They shall be of sufficient size to permit the ready and easy construction of related work. When the related work has been completed, the void remaining shall be completely filled with non-shrink Five Star Grout, Embeco 636 Grout, or equal and finished smooth.

Under the sections on Pipe Work, Plumbing, and Heating, Ventilating and Air Conditioning.
and Electrical, all related sleeves, pipe, conduit, pipe fittings, anchor bolts, gates, etc., will be furnished, set and erected. Under Concrete Work, the Contractor shall coordinate his work with suppliers of items installed in concrete and shall take all necessary precautions and exercise all possible care to maintain such work in the position set during the placing of the concrete.

4. METALS

GENERAL

SCOPE OF WORK

This work shall be subject to the conditions of the Contract and the General Requirements and shall include the furnishing of labor, materials, tools, equipment, accessories and services necessary for providing the miscellaneous items of fabricated steel, cast and wrought iron and non-ferrous metals as shown on the Contract Drawings and/or herein required.

WORK INCLUDED
This work includes the following subsections:

Miscellaneous Metals

RELATED WORK BY OTHERS

Section	6 - Touch-up and painting
Misc.	Metal furnishings, equipment and accessories as required under the remaining Sections of the Contract
Section	12 - Plumbing, HVAC

SAMPLES
Samples of the various metals and finishes proposed for the items, to be provided shall be submitted for approval, if requested by the Engineer, and approval must be received, in writing, before the items are delivered to the job site.

SHOP DRAWINGS
Furnish, as prescribed under the Contract and the General Requirements, complete shop details of the items proposed for this work.

Shop Details. The fabricator or supplier shall furnish the drawings, details and schedules necessary for the fabrication, furnishing and erection of the items which he is to supply. These are for review and approval by the Engineer and inspection by the Contractor.

Shop drawings shall identify the detail as shown on the Contract Drawings and be complete as to the detail of the item and location in the project, the metal, the size of members, the method of joining various components, the quantity, finish, the location and type of anchors, and shall include all necessary measurements. Shop assemblies which require markings for erection identification, shall have easy-to-ready markings on the shop and erection drawings. Variations in tolerances or clearance between various items and other materials should also be noted on the shop drawings.

Standard manufactured items in the form of catalog work sheets showing illustrated cuts of the items to be furnished, scale details, sizes, dimensions, quantity and all other pertinent information shall be submitted and approved in a similar manner.

Measurements given on the shop drawings or standard catalog sheets, as established from the Drawings and approved by the Engineer, shall be followed. When it is necessary to verify the field measurements, they shall be checked and established by the General Contractor. The field measurements so established shall be followed by the General Contractor and by all affected trades.

It is also advisable for the fabricator or supplier to verify construction conditions and check measurements at the building, especially if the item is to be installed by the fabricator or supplier. When this is the procedure, arrangements for checking and the repsonsibility for measurements should be by mutual agreement.

The fabricator, when submitting drawings for approval, shall call to the attention of the Engineer, any modifications or changes that will be required in the Contract Drawings and give the reason for the modifications. Where possible, such notations shall be placed on the shop drawings.

GUARANTEES
Furnish, as prescribed under the Contract and the General Requirements, guarantees covering the metal work.

PRODUCTS

MATERIALS

Metal. Metals as required, shall be the best of their respective kinds of new stock, standard sizes, and true sections as shown or indicated on the Drawings.

Steel. Steel shall conform to the requirements of ASTM Specification A36.

Unit stresses, details of construction, workmanship and painting shall conform to the requirements of the current issue of the "Standard Specifications for Structural Steel for Buildings" of the American Institute of Steel Construction.

When high strength steel bolts are used, the material shall conform to the requirements of the Specifications

ASTM A325. "High Strength Steel Bolts for Structural Joints." The dimension of the bolts, nuts and washers, the assembly of the joints and the tensioning of the bolts shall conform to the requirements of the "Specification for Structural Joints Using ASTM A325 Bolts", approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation (latest revision).

The above mentioned specifications shall govern except where the provisions of the Specifications conflict, in which event the Specifications shall govern.

Cast Iron. Cast iron items required shall be the product of a well-known manufacturer as approved by the Engineer. The style and type shall be as indicated or detailed. In physical and chemical properties and tests and in manufacture, iron castings shall conform to the requirements of ASTM Specification A-48.

Aluminum. In manufacture, physical and chemical properties and tests aluminum alloys and tempers shall conform to the following specifications:

Structural shapes and plate	6061-T6
Gratings	6063-T6
Regular plate and sheet	5050-H34

The manufacturer shall send to the En gineer certifications of the material being furnished.

FINISHES

Galvanized Steel. Items herein required to be galvanized shall receive a hot dip galvanized finish meeting the requirements of ASTM A386 for weight Class B2. These items shall be fabricated, welded, punched and/or drilled before being galvanized unless otherwise approved by the Engineer.

Shop Prime Paint. The prime coats for nongalvanized ferrous metals, excluding stainless steel, shall be shop applied by the fabricator. Subsequent coatings are required to be provided in the field under Finishes.

Cast Iron Work shall be given a black asphalt unless specifically noted otherwise.

The shop primer for steel shall be a universal rust-inhibitive primer which can be used on both submerged and nonsubmerged ferrous metal and has the ability to accept alkyds, epoxy, vinyl, coal tar, chlorinated rubber, emulsion, coal tar epoxies, epoxy ester, asphalt, and phenolic paints as finish coats. Primer shall be applied at the rate of 1.5 dry mils or as recommended by the paint manufacturer to provide the proper base for the field finish.

Prefinished Color Coat. Items hereinafter specified to have a prefinished color coat shall be factory finished with a 20 year guarantee. Color shall be as selected by the Engineer.

Anodic Clear. Aluminum required to have a clear finish shall be given a caustic etch and anodic oxide treatment conforming to Alumilite 204R1 (Aluminum Association AA-M12C11A31). Apply one final coat of clear lacquer.

Anodic Color. Aluminum required to have an anodic color finish. The finish shall be an Architectural Class 1 coating with integral Color (AA-A42). Color shall be as selected by the Engineer.

The finish shall be obtained by giving all aluminum sections a caustic etch followed by an anodic treatment to produce a high density aluminum oxide coating. The minimum coating thickness shall be 0.7 mil (0.0007 inch) when measured per ASTM B244, and the density shall be at least 32 mg per square inch when measured per ASTM B137. The permanodic color coating shall then be given a complete seal per ASTM B136.

PROTECTIVE COATINGS

Aluminum surfaces that will be in contact with concrete or mortar, when set, shall have the contact surfaces coated with an approved lacquer or bituminous paint.

Aluminum surfaces, that will be in contact with steel or other metals capable of causing a galvanic reaction, shall be coated with an approved isolation coating or material such as zinc chromate or neoprene gaskets.

Surfaces to be exposed to view shall be protected with an approved protective coating that will prevent abrasion, marring and other surface damage during shipping, receiving and installation.

All approvals shall be obtained in writing from the Engineer, before application.

EXECUTION

FABRICATION AND WORKMANSHIP

The items specified shall be fabricated in a well-equipped facility capable of producing the highest grade of metal work as shown and/or as required.

The work shall be straight and true, free from warpage or other defects and assembled in a first class workmanlike manner. Joints, corners, copes and miters shall be accurately cut, machined, filed and fitted in accordance with the best methods as required for the product.

The bolting, riveting, or welding shall be accomplished in accordance with the latest approved methods, and with due consideration for the strength and appearance of the product. Welds, where appearance requires, as determined by the Engineer, shall be ground smooth and neatly finished. Removable members shall be carefully

fitted and secured by screw fastenings or other methods as may be necessary.

Field connections shall be designed and constructed in the most practical places for appearance and ease of installation. Joining, fitting and welding on architectural and decorative items shall be concealed as far as practical. Rivets and screws should not show on prominently exposed surfaces.

The items shall be manufactured with the aid of modern equipment and by capable mechanics and all in strict accordance with the requirements under this Section of the work.

Prior to shop priming, uncoated ferrous metal surfaces shall be sandblasted in accordance with Steel Structures Painting Council Specification SP-10-63T and weld seams, sharp corners and rough edges shall be ground smooth.

ERECTION
The installation of the work of each Section varies according to the item and type of construction.

The erection work shall be performed by experienced mechanics capable of installing each unit in a plumb true and aligned manner, employing modern tools and equipment permitting the positioning of the various units in a safe and secure manner and in accordance with the shop and erection drawings.

Items to be built in, such as anchors, bolts, plates, column bases, inserts and similar items and loose lintels, shall be set by the Contractor for Concrete.

Anchors and bolts to be imbedded into concrete may be furnished without paint.

PROTECTION AND CLEANING
After installation, all exposed architectural and decorative metal items shall be properly protected by the General Contractor from the hazards of building construction until completion of the project.

MISECLLANEOUS METALS

SCOPE OF WORK

WORK INCLUDED
Pipe Supports
Construction castings where shown

Floor frames and covers
Inlet distribution manifold
Ladders

RELATED WORK BY OTHERS
Section 8 - Pipe Work
Section 12 - Duct work and small pipe supports

PRODUCTS

All items furnished shall comply with the latest Safety Standards of the State of Indiana and the fabricator shall certify that they meet the requirements of the Federal Occupational Safety and Health Act.

PIPE SUPPORTS
Pipe supports requiring 6-inch and larger steel beams shall be furnished and installed by this Contractor.

Pipe supports requiring 4-inch and smaller, structural steel members including pipe saddles, rods, hangers, concrete inserts, etc. will be furnished under Section 8 - Pipe Work or Section 12 - Plumbing, Heating, Ventilating and Air Conditioning.

CONSTRUCTION CASTINGS
The cast iron items where shown shall be equal to the product James B Clow and Sons, Traverse City Iron Works, or Neenah Foundry.

FLOOR FRAMES
Floor frames shall be steel except where aluminum or cast iron construction is shown or called for. Frames shall be fabricated of steel sections and plates in accordance with the details shown and/or standard shall be aluminum.

Frames shall be of the type indicated, neatly mitered and shall have welded corners and chors. Frames shall be flush with the finished floor and shall be carefully leveled so that the plates of gratings do not rock. Where indicated, plates shall be hinged. Frames shall be protected from damage by suitable means until the floor finish shall have been poured around them.

Cast iron frames and covers shall be as called for under "Construction Castings."

STEEL FLOOR COVERS
Steel plate covers shall be fabricated in accordance with the details shown and/or standard practice. Tops shall have an anti-slip surface and shall be provided with lifting devices. Where indicated, plates shall be hinged.

LADDERS
Metal ladders with their landings and cages shall be fabricated in accordance with the details shown.

INLET DISTRIBUTION MANIFOLD
The inlet distribution manifold shall be fabricated and erected according to details shown on the Drawings.

MISCELLANEOUS
Miscellaneous metal items not specified herein, but shown on the Drawings, shall be as detailed.

EXECUTION

See Execution under Metals - General.

6. MOISTURE PROTECTION

GENERAL

SCOPE OF WORK

This work shall be subject to the conditions of the Contract and General Requirements and shall include the furnishing of the labor, materials, equipment, accessories, tools and services for the installation of the thermal and moisture protective materials and systems as shown on the Contract Drawings and/or as herein required.

WORK INCLUDED
This work includes the following subsections:

Waterproofing
Dampproofing

RELATED WORK BY OTHERS

Section 3 - Curing compounds and hardners
Section 7 - Field painting

SAMPLES
Samples of the various finishes proposed for the items to be provided under this Section shall be submitted for approval by the Engineer and none shall be delivered to the job site until written approval is received.

SHOP DRAWINGS
Furnish, as prescribed under the Contract and the General Requirements complete shop details of the items proposed for this work.

GUARANTEES
Furnish, as prescribed under the Contract and the General Requirements, guarantees covering the moisture protection work.

PRODUCTS

See Subsections

ERECTION

See Subsections

WATERPROOFING

SCOPE OF WORK

WORK INCLUDED
Inside faces of tank walls common to occupied areas on opposite face.

RELATED WORK BY OTHERS
Section 3 - Curing compounds and hardners
Section 6 - Field painting
Subsection 5 - Dampproofing

PRODUCTS

Waterproofing materials shall be the product of one of the following manufacturers, or equal:

Koppers	Bitumastic No. 300-M
Toch Brothers	Epotox C.T.85
Tnemec	Tneme-Tar 413

MATERIALS
The waterproofing materials shall be a coal-tar epoxy chemically cured coating which will withstand considerable physical damage due to direct impact, abrasion and flexing. It shall not sag or flow at any temperature.

EXECUTION

PREPARATION OF SURFACES
Concrete surfaces shall be free of oil, laitance, soluble salt and loose concrete and shall be thoroughly dry before coating.

APPLICATION
The coatings shall not be applied at a temperature below 50°F and shall not be applied in wet weather.

Two coats shall be applied as recommended by the manufacturer of the approved materials. The first coat may be thinned as recommended for proper absorption into the surface.

The coatings shall form a finish with a dry film thickness of 20 to 24 mils.

DAMPPROOFING

SCOPE OF WORK

WORK INCLUDED
Earth retaining surfaces of concrete walls that are common to basement areas, vaults and underground pipe galleries.

RELATED WORK BY OTHERS
Section 3 - Curing compounds and floor hardeners
Subsection 5 - Waterproofing

PRODUCTS

Dampproofing materials shall be the product of one of the following manufacturers, or equal:

Koppers	Bitumastic No. 50
Sonneborn	Hydrocide No. 128
Tnemec	No. 450 Heavy Tnemecol

MATERIALS
The dampproofing material shall be a black heavy-duty tar base pitch blended with selected solvents to form a pate-like coating for use under severe corrosive conditions.

The primer for concrete work shall consist of low viscosity, low surface tension tar primer with no added solvent.

EXECUTION

PREPARATION OF SURFACES
Cracks and holes shall be repaired with concrete grout and the surface shall be dry and free of dusty, dirt, loose sand and laitance.

APPLICATION
The primer and finish coats shall be applied as recommended by the manufacturer of the approved materials.

The primer shall be applied in as many coats as is required to thoroughly saturate the surface, to be topcoated until it will absorb no more primer. Primer shall be thoroughly dried before topcoating.

The topcoating shall be applied in two coats and shall form a finished coating with a dry film thickness of 30 to 36 mils.

6. FINISHES

GENERAL

SCOPE OF WORK
This work shall be subject to the conditions of the Contract and General Requirements and shall include the furnishing of the labor, materials, tools, equipment, accessories and services necessary for providing the finishes as shown on the Contract Drawing and/or as herein required. See Room Finish Schedules on the Contract Drawings.

WORK INCLUDED
This work includes the following subsections:

Painting

RELATED WORK BY OTHERS
See Subsections

SAMPLES
Samples of the various finishes proposed shall be submitted for approval by the Engineer and none shall be delivered to the job site until written approval is received.

GUARANTEES
Furnish, as prescribed under the Contract and General Requirements, guarantees covering the items included under this part of the Contract.

PRODUCTS

MATERIALS
Materials, as required, shall be the best of their respective kinds, of new stock, as shown or indicated and as herein required.

EXECUTION

See Execution as specified under Painting.

PROTECTION AND CLEANING
After installation, exposed surfaces shall be cleaned of all foreign matter and shall be protected against damage until accepted by the General Contractor. Thereafter, it will be the responsibility of the General Contractor to maintain protection and provide final cleaning.

PAINTING

SCOPE OF WORK
This work shall include the field painting as shown and/or herein required. See specific items not requiring field painting under "Related Work by Others" and "Work Not Included."

WORK INCLUDED
In general, exposed surfaces that are delivered to the job site without a final finish shall be painted. The shop priming and intermediate shop coatings shall not be considered as included in the number of field coats specified under "Finish Paints" under this Section of the Specifications.

Ferrous metal excluding stainless steel surfaces that will be exposed in the completed work shall be sandblasted either at the point of fabrication or under this section of the work prior to placement of primers. Field fabrication, including welds and cuts shall be sandblasted, primed and painted as herein specified.

Galvanized steel items that are not excluded under Work Not Included shall be prepared, primed and finish painted as herein specified.

Bruises, mars and/or scratches in the shop painting due to handling shall be immediately touched up in the field by this Contractor prior to any storage or installation.

Painting of piping includes pipe hangers, valves and piping accessories and also includes surfaces that will be in contact with piping supports. Insulated pipe work shall be finished the same as uninsulated type.

Altered existing work or damaged surfaces that are a result of the revisions shall be painted under this item of the work. The finishes shall match the existing adjacent coatings.

Ferrous metal items that will be in contact with precast concrete slabs, masonry, etc., shall be finished painted.

Miscellaneous equipment shipped to the job site with factory applied coatings as follows shall be painted under this work as specified:

No factory finish: Surface preparation, priming and finishing painting.

Prime Coat: Surface preparation, touch-up and finish painting
Intermediate Coat: Surface preparation, touch-up finish painting.
Prefinished equipment: Touch-up as required. Equipment manufacturer will furnish necessary touch-up paint.

Color coding and identification as called for in the "Piping Color Code and Identification Schedule."

Painting as called for on the Contract Drawings, are for guidance only and do not limit the requirements for painting.

Furnish the Engineer for approval a schedule for all painting as called for in the "Painting Schedule" and "Piping Color Code and Identification Schedule" appended.

RELATED WORK BY OTHERS

Section 3 - Special non-decorative concrete finishes
Section 5 - Shop priming coats
Misc. Factory prefinished specialities, equipment, fixtures, furnishing and special construction as specified under the Contract.

WORK NOT INCLUDED
Unless specifically called for on the Contract Drawings or specified herein the following are not included:

Exterior exposed concrete surfaces and exposed concrete surfaces below the ground floor plan.

Nonferrous metals and stainless steel except copper and brass.

CONTRACTOR'S RESPONSIBILITY
It shall be this Contractor's responsibility to check the compatibility of painting materials proposed for this Contract.

This Contractor shall coordinate this work with other trades to insure compliance with these specifications.

DATA SHEETS AND COLOR SAMPLES
Specification data sheets, application instructions, color samples and a listing of all materials and colors proposed for use on the work, including designation of the area, primer required or purpose, shall be furnished to the Engineer and approval received prior to commencing work.

Specification data sheets and application instruction shall be included for each specific material proposed.

The Contractor, when so directed by the Engineer, shall make test applications of paints proposed for use on the work, at locations selected by the Engineer. Test applications shall cover an area sufficiently large to give a true color and texture effect. Final selection of paints will be made by the Engineer on the basis of the test applications. Paints used on the work shall match the test application in every respect.

GUARANTEES
It is intended to turn over to the Owner an acceptable paint job. Toward this end the Contractor shall maintain to the satisfaction of the Engineer, the painted surfaces as required under the Contract, for one year from the date of final acceptance of this job. Defects in the painting that occur during this period shall be corrected at no cost to the Owner.

PRODUCTS

PAINTING MATERIALS
Painting materials shall be those as herein specified under Field Painting Systems appended and shall be the best quality, as manufactured by the following:

Amercoat Corporation, Brea, Calif. 92621
Koppers, Pittsburgh, Pen sylvania 15222
Mobil Chemical, Kankakee, Illinois 60901
PPG Industries, Pittsburgh, Pennsylvania 15222
Tnemec, North Kansas City, Missouri 64116
Detroit Graphite, Rockford, Illinois 61101

Other manufacturers with equal products will be accepted by the Engineer.

Materials shall be brought to the job site in the original sealed and labeled containers of the manufacturer and shall be subject to inspection by the Resident Engineer on the job. Colors, where not specified, shall be selected by the Engineer.

Oil, turpentine and other thinners used in the finishing work shall meet the requirements of the latest appropriate ASTM.

EXECUTION

WORKMANSHIP

Workmanship shall be of the best grade, with materials evenly spread and smoothly flowed on, without runs or sagging of materials.

No adulterations or changes of proportions shall be permitted unless recommended by the manufacturer and approved by the Engineer. Paint shall be applied in strict conformity with the manufacturer's directions.

Surface Preparation. Prior to applying specified finishes, exposed surfaces requiring field painting shall be properly filled, scraped, sanded, etched, brushed, sandblasted and/or cleaned, as required to provide surfaces free from dirt, loose crystals, rust, scale, oil and grease.

Surfaces to receive special coatings shall be prepared in accordance with the manufacturer's recommendations. Surfaces shall be inspected and accepted by this Contractor before coatings are applied.

No change in treatment of surfaces shall be permitted unless recommended by the manufacturer and approved by the Engineer.

1. Metals Preparation.

Uncoated ferrous metal surfaces shall be sandblasted in accordance with Steel Structures Painting Council Specification SP-10-63T. Grind smooth weld seams, sharp corners and rough edges.

Nonsubmerged galvanized surfaces without a paint grip bonderized finish, requiring field painting, shall be treated with an approved chemical cleaner followed by a sealer coat (metal conditioner) prior to prime and finish coats.

Nonferrous metals that are to receive a painted finish shall be solvent cleaned prior to recommended pretreatment.

Pretreatment. Nonsubmerged galvanized metal and non-ferrous metal shall be pretreated.

The galvanized pretreatment shall be allowed 30 minutes for reaction to take place, then the residue shall be removed with a water rinse.

Field Priming and Sealing. In general, metal surfaces requiring field painting shall receive a priming coat before shipment from the shop. Such priming coats shall be compatible to subsequent applied coats.

Wherever work requiring field painting, bears no priming coat, or has a damaged shop coat, it shall have the surface prepared as specified and shall receive an approved priming coat, applied before and in addition to the finish coats required.

Application. The first field coat shall be that best suited for use with the surfaces to be covered and with the final coats. Whenever the finish color permits, the first coat shall be slightly tinted to the end that complete coverage of the final coat may be assured.

Finish coats shall be applied in a uniform manner and of the minimum mil thickness as called for. Where the mil thickness is omitted. It shall be as recommended by the manufacturer to given an excellent surface finish. Finished surface thickness shall be subject to spot checking by the Engineer, using a wet and/or dry gauge. Deficiencies in required thickness shall be corrected by addition of extra coats at no additional cost to the Owner.

Thinners as recommended by the manufacturer shall be used and the amounts shall not exceed recommendations by them.

Paints shall not be applied on damp surfaces or on preceding coats not thoroughly dried and shall not be applied on outside surfaces in extreme cold, frosty, foggy or damp weather, unless permitted by the materials manufacturer in the standard application specification.

Materials shall not be applied when the temperature is below 50°F. Paint applied on outside surfaces shall be allowed to dry two to four days between coats and outside surfaces shall be allowed to dry at least 24 hours between coats. No change in drying shall be permitted unless recommended by the manufacturer and approved by the Engineer.

Spraying. Spraying will be permitted only for such work as approved by the Engineer.

Spraying equipment shall be of a type and capacity adapted to the work and shall be subject to the Engineer's approval. Spraying equipment, including temporary rigid piping, flexible hose, nozzles, etc., shall be kept in such condition as will insure against breakdowns and stoppage.

Particular care shall be exercised to prevent the soiling or damaging of adjacent work. Brushing shall immediately follow the spraying when necessary to eliminate wrinkling, blistering, and air holes.

Protection, Special Precautions and Cleanup. Reasonable care shall be used to prevent the splattering. Drop cloths and masking materials shall be used.

Splashes, drippings and stains shall be thoroughly removed upon the completion of the work.

Lighting fixtures shall be covered and protected, or removed and replaced upon completion of the work. Electric switch plates, surface hardware and similar equipment shall be removed, protected and replaced.

Materials shall be stored and mixed in a well ventilated location as designated or approved by the Engineer, kept in a neat condition and shall be sealed or covered when not in use. Empty cans and containers shall not be allowed to accumulate on the premises. Oily waste rags, etc., shall be collected each day and destroyed or stored in a tightly covered metal container.

During surface prepration the Contractor shall take all precautions necessary to protect related work. Equipment items and work areas shall be tightly covered so as not to be damaged by the painting operation. Special attention shall be made to protect equipment items during sandblasting operations.

The Contractor shall be responsible for cleanup of painting materials upon completion of his work.

As soon as the painting work is accepted by the General Contractor it will become his responsibility for protection, final cleaning and touch-up.

FIELD PAINTING SYSTEMS

The following systems may vary from the coverages and mil thickness shown if recommended by the paint manufacturer and approved in writing by the Engineer. Number of coats shall be as required to obtain the mil thickness specified.

In general, exposed surfaces of factory and/or shop primed work shall be finish painted. The factory and/or shop prime coats shall not be considered as included in the number of coats required in the finish painting systems herein specified.

PRETREATMENT

Nonsubmerged Galvanized Metal. Apply one brush coat of phosphoric acid.

Nonferrous Metals. Apply one coat of a two-component wash primer formulated with a zinc chromate pigmented polyvinyl butyral resin and phosphoric acid at a minimum of 0.3 dry mils and maximum of 0.5 dry mils thickness.

FIELD PRIMING AND SEALING

Metal Primer. Apply one coat of an universal rust-inhibitive primer which can be used on both submerged and nonsubmerged ferrous metal and has the ability to accept alkyds, epoxy, vinyl, coal tar, chlorinated rubber, emulsion, coal tar epoxies, epoxy ester, asphalt, and phenolic paints as finish coats. Apply at the rate of 1.5 dry mils or as recommended by the manufacturer.

Nonsubmerged Galvanized Metal Primer. Apply one coat of approved galvanized iron primer that will form a permanent bond coat for the finish coat.

Sealant for Bituminous Coated Surfaces. Apply 2.4 dry mils of synthetic alcohol-soluble resin and titanium pigment.

FINISH PAINTS

Interior Nonsubmerged Metal. If an alkyd finish is called for apply 2.8 dry mils of a medium to long alkyd resin (two coat minimum) gloss finish, otherwise, apply 3.5 dry mils of a polyamid-cured epoxy resin finish, two coat minimum.

Exterior Nonsubmerged Metal. If an alkyd finish is called for apply 2.8 dry mils of a medium to long alkyd resin (two coat minimum) gloss finish, otherwise, apply 3.0 dry mils of a vinyl plastic resin intermediate finish and 1.0 dry mils of a vinyl plastic resin finish coat.

*Submerged and Intermittently Submerged Metal. Apply 16 dry mils of a catalized coal-tar epoxy finish.

* If the time period between coats exceed that recommended by the paint manufacturer, a solvent wash shall be applied prior to placement of a second coat.

PAINTING SCHEDULE

Furnish the Engineer for approval, prior to commencing any painting, a schedule similar to that below:

Item and/or Location	Type Material	Coverage per Coat	Paint Manufacturer
Pretreatment			
Primers			
Interior Nonsubmerged metal - epoxy coat			
Interior Nonsubmerged metal - alkyd resin			
Exterior Nonsubmerged metal - vinyl coat			
Exterior nonsubmerged metal - epoxy coat			
Submerged and intermittently submerged metal			

COLOR CHARTS
Provide (two each) standard color charts for each different type paint. Color chips will be used to select colors.

PIPING COLOR CODE AND IDENTIFICATION SCHEDULE

Furnish the Engineer for approval, prior to commencing any painting, a schedule showing colors and markings proposed.

All piping shall be completely finished as herein specified.

Pipe markings shall be placed on exposed pipe. The markings shall be located at frequent intervals and shall include an appropriate name and direction of flow arrow. Letters and arrows shall be proportioned to the size of the pipe, shall be located in an area that will facilitate readings and shall be black on light base colors.

The color and identification shall be as required by the Owner.

7. SITE IMPROVEMENTS AND RESTORATION WORK

SITE IMPROVEMENTS

GENERAL

SCOPE OF WORK
This work shall be subject to the conditions of the General Requirements and include the furnishing of labor, materials, tools, equipment, accessories and services necessary for providing and installing the items as shown on the Contract Drawings and/or as herein required.

The work under this section shall include the construction and/or reconstruction of all driveways, walks, curb and gutter, landscaping, including furnishing, placing and finish grading of top soil, seeding and sodding and rip-rap.

Final grading to the contours shown on the Drawings minus four (4) inches shall be accomplished under the Earthwork section of this Contract.

SHOP DRAWINGS AND GUARANTEES
Furnish, as prescribed under the General Requirements, Shop Drawings and Guarantees covering the items included under this section of the Contract.

The Contractor shall furnish to the Engineer, for approval, sieve analyses and/or mix designs of the various paving and subgrade materials to be used under this section of the work.

DRIVEWAYS, WALKS, CURBS AND GUTTERS

EARTHWORK AND BASE CONSTRUCTION
The Contractor shall construct the driveway and cul-de-sal and base for the bituminous concrete driveways and cul-de-sal at the plant site as shown on the Drawings. He shall excavate or fill where necessary for roadway construction and the excavated earth shall be used for fill material at the site. The subgrade shall be smooth, trimmed and thoroughly compacted to the required grade, line and cross-section. The finished soil subgrade surface shall not vary more than ½-inch from a ten foot straight edge and be within 0.1 foot above or below the established grade. The subgrade shall be thoroughly compacted to 95% of maximum density.

CUT JOINTS
The existing bituminous driveway shall be saw cut adjacent to the new bituminous concrete driveway. The saw cut shall not be nearer than 5 feet to an existing transverse joint. The existing bituminous surface shall be cut full depth. Cut joints shall be made using a carborundumsaw. Before the new driveway is placed, all angular and ragged irregularities on the edges of the cut pavement shall be removed giving a smooth and regular edge of pavement.

After the subgrade has been brought to the required grade and cross-section, a 10-inch layer of road gravel shall be placed on the subgrade. The 10-inches of gravel shall be placed in two 5-inch layers. The first layer shall be deposited to a width 12-inches greater on each side of the driveway than the finished width including curb. The edge shall then be built up to hold the top course of stone in place and to permit the roller to lap over the edge of the driveway when compacting the top course. The gravel shall be thoroughly compacted after placing each layer. The top course shall be graded to the required grade and cross section. After completion, the finished driveway gravel base shall nowhere be less than 10-inches thick. Gravel shall be the standard of the City of Fort Wayne Board of Public Works.

As an alternate and with the approval of the Engineer, bituminous base as hereinafter specified may be substituted for the above specified gravel base for bituminous concrete surfaces.

The bituminous base shall have a total completed thickness of 7-inches and shall be placed and compacted in two 3½-inch layers. The bituminous base shall be plant mixed and the proportion of asphalt by weight shall be not less than 4.0 percent. The Contractor shall furnish a mix design to the Engineer, as specified hereinafter under Bituminous Concrete.

BITUMINOUS CONCRETE DRIVEWAYS
This work shall consist of conditioning and treating the base course with prime material and constructing thereon a two course bituminous concrete surface consisting of mineral aggregate, mineral filler, and bituminous material combined by a stationary batch plant mix method.

Upon the prepared gravel base a prime coat of MS-Op shall be applied at a rate of 0.25 gallon per square yard. The binder course shall then be applied and rolled. Upon the binder course a bond coat of SS-1h or MS-2a8.04.06 shall be applied at a rate of 0.10 gallon per square yard and immediately thereafter the wearing course shall be applied and rolled. The bond coat shall be applied to clean surfaces only and the binder course shall be swept clean if necessary prior to application of the bond coat. Each square yard of the completed bituminous concrete pavement shall weigh a minimum of 110 pounds per inch unless noted otherwise on the Drawings.

The materials shall conform to the Standards of the City of Fort Wayne Board of Public Works.

All joints in the bituminous concrete shall be vertical joints. Where the joints are allowed to set before the adjoining pavement is placed, such joints shall be painted with bituminous material as specified hereinbefore for bond coat.

CONCRETE WORK

General. Concrete curbs and gutters shall be built where shown on the Drawings.

Concrete shall be Class A concrete as specified under Section 3 - Concrete. Cement shall be air-entraining cement.

The subgrade shall be thoroughly compacted to 95% compaction by tamping. After wetting the subgrade, the concrete shall be deposited thereon and spaded along the form faces. Concrete shall be alternately tamped and screeded until the voids are removed and the surface has been brought to the required grade. The surface shall be floated to produce a smooth dense surface free from irregularities and, as soon as all excess moisture has disappeared, finished by light brooming. All edges and joints shall be rounded to a radius of 1/4-inch with a finishing tool.

As soon as concrete surfaces have hardened sufficiently to prevent marring, they shall be covered by an approved curing compound, or they shall be thoroughly wetted and cured by an approved method for a period of six days unless otherwise directed by the Engineer.

Concrete Curbs and Gutters. Concrete curbs and gutters shall be as detailed on the Drawings.

Place one-inch expansion joints at spring lines of cul-de-sal and at end of existing curb.

Intermediate plane of weakness joints shall be placed at approximate 10 foot intervals between expansion joints.

LANDSCAPING

GENERAL
Landscaping shall include all new landscaping as shown on the Drawings and the repair of areas disturbed by the construction work around new or existing structures or piping.

FURNISHING AND PLACING TOPSOIL
The upper 4-inches of depth of all working areas to be backfilled and/or graded, including backfill and cut areas, and all areas disturbed by the construction work, including trenches, shall be made with selected top soil, preserved or secured elsewhere for this purpose. This top soil shall be rich, loam soil, free from sod, weed stalks, or debris and entirely suitable for the making of a first class lawn. Topsoil brought in from off the job site shall be incidental to the work under this contract.

Placing of top soil shall be made to an elevation above those required by an allowance for shrinkage of 15% of the depth of fill. The finished filling and grading shall be raked smooth and all stones and debris shall be raked up and hauled away.

SODDING
All slopes three horizontal to one vertical and steeper and other areas noted on the Drawings shall be sodded. Sod shall be brought in from the outside. All sod shall conform to the Indiana State Highway Specification F-48. Sodded areas shall be kept continuously moist until a good growth is indicated or until directed by the Engineer to discontinue watering. Suitable wooden pegs shall be used to pin the sod to the sloping banks, using not less than one peg for each two square feet of sod surface. These pegs shall be driven flush with the sod surface.

SEEDING
The remaining landscaped area shall be seeded. Graded areas shall be carefully raked to even surfaces and all stones, sticks and other debris removed therefrom. Seeding mixture shall be 2 pounds chewing fescue, 2 pounds kentucky blue grass and 2 pounds perennial rye and shall be sown at the rate of 6 pounds/1000 square feet of area. The seeded area shall then be covered by a continuous blanket of mulch material to approximately a 2 inch depth. Mulch material shall consist of an approved straw, free from noxious weeds. The mulch shall be held in place by a bituminous material (RC-70

or AE-90T) applied as a film. Sufficient amount shall be used to hold the mulch material in place. After the lawns have been seeded, they shall be kept continously moist by sprinkling and maintained by mowing until the entire work is accepted by the Owner.

The area to be seeded shall be given an application of commercial fertilizer with a spreader specifically made for that purpose. Fertilizer shall have a minimum analysis of 4% available nitorgen, 16% available phosphoric acid and 16% available potash. The fertilizer shall be applied at the rate of 5 pounds per 1000 square feet.

RIP RAP

GENERAL

Rip rap shall be constructed at the locations shown on the Drawings and shall be broken concrete, without reinforcing steel, broken rock or field stone. The rip rap shall be a minimum of 8-inches in thickness and the voids shall be filled with Class "B" concrete. The minimum dimension of the pieces used in the rip rap shall be 8-inches.

As an alternate to the concrete rip rap specified above the use of 3-inch to 7-inch stone placed in a 9-inch deep wire mesh mattress will be permitted.

The mattress units shall be subdivided into compartments extending the full width of the mattress unit by the insertion of partitions made of the same mesh as the rest of the mattress unit. The partitions shall be secured in proper position on the base such that no additional tying at this junction will be necessary. All perimeter edges of the mesh forming the mattres unit shall be securely salvaged or bound to have at least the same strength as the body of the mesh.

Prefabricated wire ties or connecting wire shall be supplied in sufficient quantity to fasten securely all edges of the mattress unit and its partitions. The wire ties or connecting wire shall meet or exceed the same specifications as the wire used in the mesh.

The wire mesh shall be made of galvanized steel wire having a minimum size of U.S. Steel Wire Gauge No. 14. The tensile strength of the wire shall be in the range of 60,000 to 85,000 psi. The minimum zinc coating of the wire shall be 0.80 ounces per square foot of uncoated wire surface as determined by tests conducted in accordance with ASTM Designation A-90. The maximum linear dimension of the mesh opening shall not exceed 3-1/2-inches and the area of the mesh opening shall not exceed 6 square inches.

The areas shall be kept neat and clean and upon completion of work, the site shall be left in an orderly condition. The Contractor shall dispose of all excess materials and debris.

8. PIPE WORK

GENERAL

SCOPE OF WORK
This work shall be subject to the conditions of the General Requirements and include the furnishing of labor, materials, tools, equipment, accessories and services necessary for providing and installing the items as shown on the Contract Drawings and/or as herein required.

It shall also include the erection of equipment furnished under Valves and Gates and Instrumentation which is related to piping.

Equipment furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with detail drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer as approved by the Engineer. Special attention shall be given to the General Equipment Stipulations of the General Requirements.

DRAWINGS
The drawings are not intended to show every detail of construction or location of piping or equipment. Where building construction makes it necessary or advisable to change location of piping or equipment, the Contractor shall so inform the Engineer for his approval.

The Contractor shall give to all trades the exact locations and sizes of all openings required for piping and equipment plus information as to all spaces required.

WORK INCLUDED
The principal interior and exterior pipe lines and their locations, to be included under this heading, together with the pipe material required in each case, are shown on the Schedule.

In general, unless noted on the drawings, all piping 4 inches in diameter and larger shall be part of this work, except floor and roof drain systems which are under Plumbing, Process Piping and HVAC.

Work shall include the dismantling of existing piping and supports, where required and/or shown or noted on the drawings. Piping connections shall be made to existing piping or structures, valves, gates, measuring devices, pumps and other equipment, including equipment erected under other divisions of the work. Piping shall contain necessary unions or companion flanges to allow ease of equipment removal.

Complete all the demolition work and repair thereof of existing walls and slabs as required for the installation of this work including grouting of all sleeves and castings.

Excavation, disposal of surplus excavated materials; pipe bedding materials, backfill of trenches after pipe is installed and bedded, placing and maintaining temporary roadway surfaces over trenches in streets, drives and parking areas, trench sheeting and bracing, if required, and control of water shall be accomplished under this work.

Furnish and install all pipe encasement concrete meeting the requirements as specified under Concrete.

All necessary joint and coupling materials, including bolts, nuts and gaskets, wall castings or sleeves, and standard or special fittings shall be provided as part of this work. Hangers, supports, anchors, blocking, harnesses, and other necessary closure pipe sections and special fittings shall be furnished.

Furnish, set and secure in proper alignment all required sleeves and castings.

All work under this section shall be done in accordance with standard practices as recommended by the manufacturer and AWWA.

The furnishing of all shop applied interior and exterior pipe linings and coatings, as specified, including the field repair thereof, shall be part of this work.

Plugs in open ends of pipe, temporary bulkheads, protection of surface and subsurface improvements, cleaning, pointing, testing and sterilization, as required, shall be included as incidental cost of laying the pipe, and part of this work.

All pipe insulation shall be accomplished under Mechanical Insulation. Under this section of the work, all shop applied surface coating shall be furnished as herein specified and pipe testing accomplished prior to insulating.

RELATED WORK BY OTHERS
Related work will be done under the following sections of the specifications:

Section	3 - Concrete
Section	6 - Finishes
Section	7 - Site Improvements & Restoration Work
Section	9 - Valves and Gates
Section	11 - Mechanical Insulation
Section	12 - Plumbing and HVAC
Section	13 - Instrumentation

All exposed pipe field applied finish painting, including

preparation and repair of existing painted surfaces, shall be accomplished under Finishes.

WORK NOT INCLUDED
Restoration of roadway, driveway and parking surfaces, concrete sidewalks, curbs and gutters, lawns and shrubbery shall be under Site Improvements and Restoration Work - Section 7.

CODES, ORDINANCES AND STANDARDS
It shall be the Contractors responsibility to check local, municipal, and State codes and ordinances which may pertain to this division of the work. Discrepancies between said codes and ordinances will be resolved by the Engineer.

Manufacture, storage and erection of equipment under this division of the work will be in accordance with current ASA (ANSI), AWWA and ASTM Standards. Standards and specifications referenced herein shall be the current published edition.

The manufacturer of the pipe and fittings shall furnish the Engineer a certified statement that all pipe and fittings furnished by him meet the material requirements and have been inspected and tested in accordance with the applicable specification and/or standard.

SHOP DRAWINGS AND GUARANTEES
Furnish, as prescribed under the General Requirements, Shop Drawings and Guarantees covering the items included under this section of the Contract.

The Shop Drawings shall be fully dimensioned drawings showing the piping in full detail with exact locations, dimensions and schedules of all pipe, fittings, hangers, supports and appurtenances. They shall be made in accordance with the general information shown on the drawings and special information furnished by the several manufacturers of equipment. Where special fittings are required, they shall be shown in large detail with all necessary dimensions. One-line drawings are not acceptable.

Each pipe section, special fitting, casting, sleeve and appurtenance shall be identified on the drawings by its respective erection mark.

Design details of joints and joint restraint shall be submitted to the Engineer for his consideration and approval before ordering any pipe.

TRENCH EXCAVATION AND BACKFILL

TRENCH EXCAVATION

CLEARING AND GRUBBING
The areas required for construction of the proposed pipe work and structures shall be cleared of all trees, stumps, roots, brush, rubbish, and other objectionable matter. Such materials from clearing operations shall become the property of the Contractor and shall be removed from the site.

CLASSIFICATION OF EXCAVATION
Earth, as a name for excavated material, shall include all glacial deposit whether cemented or not, except solid boulders one-half cubic yard or more in volume; it shall include all alluvial deposits and material of every kind that can be excavated with equal facility by the equipment and means used for other earth excavation in the work.

Rock, as a name for excavated material, shall include preglacial solid ledge rock that can be removed most practically by blasting, barring or wedging or by some other standard method of quarrying solid rock; it shall include solid boulders of one-half cubic yard or more in volume. It shall include existing concrete, masonry with mortar joints or other existing structural work that can be excavated practically only by methods of quarrying solid rock. It shall not include fragile, friable or disintegrated materials of any kind that can be excavated with equal facility by equipment and means used for earth excavation in this work.

METHOD OF EXCAVATION IN EARTH
All excavation shall be by open cut from the surface except in special cases where tunneling under pavement, or structures, may be required, or where tunneling under the root system will be required for tree root protection. All excavation shall be made in such manner and to such depth, length and width as will give ample room for building the structures, for bracing, sheeting, and supporting the sides of the excavation, for pumping and drainage of ground water and sewage which may be encountered, and for the removal of all materials excavated. Special care shall be taken so that the soil below the bottom of structures to be built shall be left undisturbed so that a firm bed will be provided for construction.

METHOD OF EXCAVATION IN ROCK
Every trench in rock must be fully opened for at least 30-feet in advance of any place where pipe is being laid. The rock shall be excavated to a depth of six (6) inches below the invert grade and six inches distance on each side of the pipe to permit the placing of the minimum thickness of bedding.

Where blasting is necessary, this work shall be carried on with due regard for the safety of workmen, pedestrians

and private and public property. The method of "covering" blasts, amounts of charges used, and the general procedure of carrying on such work shall be under the supervision of someone thoroughly experienced in handling explosives.

LIMITS OF TRENCH EXCAVATION

Trenches for pipes shall be excavated so that there will be a minimum clearance of six inches on each side of the barrel of the pipe and a maximum width of trench at the level of the top of the pipe of not more than O.D. of the pipe plus 12-inches on each side of the pipe barrel. The maximum width of trench at ground surface level adjacent to utility poles shall not be more than O.D. of the pipe plus 36-inches on each side of the outside of the pipe barrel. Trenches shall be at all times of sufficient width to permit the pipe to be laid and first-class construction methods to be used. Sufficient space shall be provided in the trench to permit the joint to be properly made. Joint holes may be provided in the excavation with overhanging sides provided the material excavated is of such a nature as to make this procedure safe for the workmen. Before excavation is started in either bituminous or concrete paved streets, the paving shall be cut by means of concrete saws or air spades, to a neat and straight line along the top edge of the intended trench opening.

The last six inches of depth of trench in granular material shall be carefully excavated and trimmed by hand to exact elevation and contour of the pipe. Where the trench excavated for pipe is in rock or clay soil, the trench bottom shall be undercut a minimum of six inches below the final location of the pipe, and bedding material, hereinafter specified under Pipe Installation, shall be placed and compacted to the underside of the pipe. If the subgrade is disturbed the space shall be refilled with bedding material solidly tamped to form a firm foundation for the pipe.

STONE REFILL

In locations where the soil at the bottom of the trench is unstable, the Contractor shall excavate below the trench bottom and refill with crushed stone, slag or crushed gravel. Where refill is ordered by the Engineer, the Contractor will be paid by change order to the Contract. The price for refill shall include the additional excavation and the refill material. Stone placed in the trench by the Contractor in conjunction with, and/or in lieu of, dewatering the trench and not ordered by the Engineer, will not be considered stone refill and will be at the Contractor's expense.

AMOUNT OF TRENCH OPENING

In excavating for pipelines, the excavation shall at all times be finished to the required grade for an adequate distance in advance of the completed pipeline, but, unless otherwise permitted by the Engineer, not more than 50-feet of trench shall be open at one time in advance of the pipe. The length of street which may be occupied by the construction work at any one time shall be subject to the direction of the Engineer and will be based on the requirements of use of the street by the public. No more than 600 consecutive feet of length of the street shall be occupied at one time, and vehicle traffic through the street shall not be entirely stopped without the permission of the Engineer.

SHEETING, BRACING AND SHORING

Where required to properly support the surfaces of excavations, to protect the construction work, adjacent work or workmen, sheeting, bracing, and shoring shall be provided. If the Engineer is of the opinion that at any point sufficient or proper supports have not been provided, he may order additional supports at the expense of the Contractor, but neither the placing of such additional supports by the order of the Engineer nor the failure of the Engineer to order such additional supports placed shall release the Contractor from his responsibility for the sufficiency of such supports and the integrity of the work. In the removing of sheeting and bracing after the construction has been completed, special care shall be taken to prevent any caving of the sides of excavation and injury to the completed work or to adjacent property.

SHEETING LEFT IN PLACE

Sheeting, bracing and shoring shall not be left in place after completion of the work except as required by the Engineer. Where required to protect the work, adjacent structures or property, sheeting, bracing and shoring shall be left in place, but shall be cut off or left not less than two feet below the established surface grade. Sheeting, shoring, or bracing so required to be left in place shall be considered as a change in the work.

DISPOSAL OF WATER AND SEWAGE

The Contractor shall remove by well points, pumping, bailing or other acceptable method any water which may accumulate or be found in the trenches or other excavations to be made. He shall take all necessary precautions to keep the trenches and other excavations entirely free of water during construction of pipelines and structures. Newly laid concrete shall be adequately protected from injury resulting from ground water or sewage or from the handling or disposal of water or sewage. No drainage ditches shall be placed within the area to be occupied by any structure except as permitted by the Engineer.

The Contractor shall at all time have upon the site sufficient pumping equipment ready for immediate use to carry out the intent of this section. All cost for dewatering trenches shall be incidental to the Contract.

DIVERTING EXISTING SEWERS

Where existing sewers or drains are encountered in this work, adequate provision shall be made for diverting the flow in the existing sewers so that the excavation will be

kept dry during the progress of the construction work. Upon completion of the construction work the existing sewers shall be restored or otherwise provided with an adequate outlet as directed by the Engineer.

CONCRETE CUTS

When the trench must be cut through concrete pavement, driveway or sidewalk, particular care shall be taken not to unnecessarily damage the adjoining areas of pavement, driveway or sidewalk. All cuts through existing surfaces shall be made with a concrete saw, sawing deep enough to allow a straight cut parallel with longitudinal and transverse construction or contraction joints.

CROSSING EXISTING STRUCTURES

During construction, it may be necessary to cross under certain sewers, drains, culverts, water lines, gas lines, electric conduits, and other underground structures. Every effort shall be made to prevent damage to such underground structures. Wherever such structures are disturbed or broken, they shall be restored to good condition. Specified Granular Fill shall be placed as described hereinafter.

BACKFILL

BACKFILLING TRENCHES

After the pipes have been laid and inspected, the trench shall be backfilled. Under the haunches, at the sides and top, from the bedding, hereinafter specified under Pipe Installation, to a level at least one foot above the top of the pipe, sand or pea gravel, as specified for bedding, shall be deposited and carefully compacted by machine tamping in layers not to exceed six inches in depth, 95% compaction required. The cost of sand or pea gravel from the bedding to one foot above the pipe shall be included in the price for this work.

Specified compaction shall be acquired with the use of a bulldozer, mechanical tamper, or other similar and effective equipment. Specified compaction means not less than 95% (not average 95%) of the maximum unit weight when tested in accordance with the specifications of the ISHD for embankments. If the excavated material is not suitable to obtain 95% minimum compaction the Contractor shall, at his expense, remove unsuitable materials or add granular materials or both to obtain 95% minimum compaction as previously specified.

Compaction tests will be made by a representative of the Owner and paid for by the Owner.

The remainder of the trench backfill shall be "Job Excavated Backfill" or "Granular Fill" as specified hereinafter.

Job Excavated Backfill shall be defined as job excavated material, free from frozen earth, boulders, rocks, stones larger than 6-inches in size, debris and organic material.

Granular Fill shall be defined as sharp sand, gravel, or crushed stone, free from lumps of clay, soft or flaky material and shall conform to the ISHD Specification, Sub-base No. 1 or No. 2 or "B" Borrow, or to the following grading requirements:

Sieve Size	% Passing
2½-inches	100
1-inch	60-100
No. 100	0-30
Loss by washing	0-7

Material excavated from the trench shall be used as Granular Fill when in the opinion of the Engineer it meets the Granular Fill grading requirements. Granular Fill hauled in from off the site shall be incidental to the work under this Section.

All trenches in paved streets, traveled roadways, parking areas and driveways shall be backfilled with Granular Fill from the level one foot above the top of the pipe to a level 10-inches below the finished grade. The Granular Fill shall be placed in not more than 6-inch layers and thoroughly and uniformly compacted by machine tamping, 95% compaction required. With the approval of the Engineer, water jetting may be accepted in lieu of tamping in 6-inch layers for Granular Fill only.

Trenches in all other areas shall be backfilled from a level one foot above the top of the pipe to original ground surface with Job Excavated Backfill and compacted to 95% maximum density.

Trenches under concrete sidewalks shall be backfilled from a level one foot above the top of the pipe to a level 4-inches below the finished grade of the sidewalk with job excavated backfill and compacted to 95% maximum density.

Wherever gas mains, water mains, sewers, etc., cross the trench, Granular Fill shall be used for backfill from the bottom of the trench up to the spring line of the pipe crossing the trench, compacted in six-inch layers so as to thoroughly support the pipe across the trench. Granular Fill so required shall be considered incidental to the work.

Any depression resulting from settlement of the trench backfill prior to the date of total acceptance of all work under this contract shall be brought to proper grade and surface, and made to match the adjacent surface as specified hereinbefore.

TEMPORARY ROADWAY SURFACES

In all areas where the trench passes through existing roadways, drives, or parking areas, the Contractor shall

provide temporary roadway surfaces under this section of the work. Such surfaces shall be 10-inches of road gravel, placed in two 5-inch layers and compacted. Road gravel shall meet the City of Fort Wayne BPW Standard.

Under this work the Contractor shall maintain temporary roadway surfaces by periodic grading and dust control. No additional payment will be allowed for placing and maintaining temporary roadway surfaces.

BACKFILLING AROUND MANHOLES
As soon as practicable after concrete structures have set, forms and debris have been removed, the surface of the concrete pointed up, and the structures have been inspected and approved, the excavated area around the structure shall be backfilled up to the specified grade with Granular Fill or Job Excavated Backfill, as called for on the drawings for the adjacent trench, and as defined hereinbefore. The fill shall be made in layers not to exceed six inches in depth, and be thoroughly compacted by machine tamping. No large boulders or masonry shall be placed in backfilling. No backfilling will be placed about manhole walls within 48 hours after the plaster coat has been applied to the outside of the walls nor shall backfilling be placed about concrete structures until the concrete has attained at least 75% of its design strength, and approval of the Engineer has been obtained.

DISPOSAL OF EXCAVATED MATERIAL
Excavated material, where suitable, shall be used in backfilling around pipelines and other structures. All material in excess of the quantity required for backfilling or unsuitable material shall be hauled away by the Contractor. Proposed haul routes between the site and disposal areas shall be submitted by the Contractor to the Owner for approval prior to commencing this work. It shall be the responsibility of the Contractor to obtain such spoil areas as may be required, except that the Engineer may direct the Contractor to dump materials at any site designated by the Owner within a two-mile radius of the work area. The Contractor shall provide all labor and equipment for maintaining haul routes and for spreading such material at the place of dumping and shall leave the area in a neat condition, satisfactory to the Engineer.

PIPE INSTALLATION

STORAGE
All pipe and related items installed under this division shall be stored as recommended by the manufacturer. The Contractor shall take all actions necessary to protect all items installed under this division including furnishing all special storage areas required by equipment manufacturers. Pipe shall be stored on suitable timber skids free from contact with the ground.

Gaskets shall be stored in as cool, clean, and shaded a place as practicable.

HANDLING
All items installed under this division of the work shall at all times be handled as recommended by the manufacturer and in such a manner as to avoid any damage. All special handling equipment and temporary supports shall be furnished by the Contractor.

Items will be subject to inspection and approval upon delivery to the job site and after storage. No cracked, broken or damaged pipe shall be used. In the event coatings are damaged, the damaged area shall be recoated with an approved coating similar to that specified for that item.

Steel pipe shall be handled by means of rubber or fabric slings. No hooks shall be permitted to come in contact with joint rings or be inserted in the ends of the pipe and fittings for any reason. During handling, hauling and storage of pipe, each piece shall be kept from contact with adjacent piece by means of wooden blocks or timbers.

LAYING AND ERECTING PIPE
Pipe shall be installed as recommended by the manufacturers or by the applicable AWWA installation manual or specification. Pipe shall be carefully laid to line and grade as shown on the Drawings. Care shall be taken to keep the interior of the pipe clean and free from dirt and other foreign materials. Bulkheads or other means shall be used at the open ends of the pipe for this purpose. At the end of each day's work, ground buried pipe shall have its working end bulkheaded.

DEFECTIVE PIPE
No pipe or special casting known to be defective shall be laid in the work. Any piece found to be defective after it has been laid shall be removed by the Contractor and replaced by a sound and perfect piece.

If the major part of a defective pipe is sound, the good end may be cut off and used. The cutting of pipes for this and any other purpose shall be done by skilled workmen, and in such manner as will not injure the pipe. Every such cut shall be square and smooth. Cut surfaces shall be recoated as specified for the pipe.

FIELD CUTTING PIPE
The spigot ends of all pipe lengths, which have been cut in the field, shall be ground to a smooth surface and painted with two coats of asphaltum metal protective paint.

CONCRETE ENCASEMENT
Where shown on the Drawings or directed by the Engineer, pipe work shall be encased in concrete. In general, pipe will be encased when it passes under structures. Pipe to be encased shall be supported on wood blocking at least at two points for each length of pipe and joints made and the line tested wherever specified. Blocking shall be of sufficient size to raise the pipe at least 6-inches above the bottom of the trench so that a 6-inch encasement may be placed entirely around it. In addition, pipe lines under floors shall be anchored to and supported from the structure above. Steel bar hangers shall be placed around the pipe, embedded in the encasement and anchored into the concrete above. Hangers shall be ½-inch bars spaced not over 3-feet 0-inch apart and shall be furnished with piping. After an approved test of the pipe line, concrete encasement shall be placed.

CONCRETE CRADLE
Pipe work shall be placed on Class C concrete cradle in locations and according to details shown on the drawing.

BEDDING
Where the subgrade is disturbed during excavation, the space shall be refilled with bedding material solidly tamped to form a firm foundation for the pipe. At least the bottom quarter of the pipe shall be laid on a sand or pea gravel bedding, except that the bedding shall be exclusively pea gravel for pipe 48-inches and larger in diameter. Bedding shall be compacted by machine tamping in layers not to exceed 6-inches in depth with 95% compaction required.

Sand shall be a sharp sand, free of lumps of clay or debris, with 100 percent passing a 1/4-inch sieve, and shall be approved by the Engineer. Pea gravel shall be unwashed and shall be 1/4-inch to 5/8-inch in size. The Contractor shall provide pea gravel and sand from off the site, except where the trench passes through well defined strata of sand or gravel. No additional payment will be made for the granular bedding described above.

EQUIPMENT CONNECTIONS
The connecting piping to pumps and other equipment shall be supported independently of the pump or equipment so as to avoid any strain on the pump or equipment. All equipment connections shall be flanged or have unions to facilitate removal of the equipment. Piping to vibrating equipment shall contain a control rodded flexible flange connections of Buna N equal to Metra Flex or Mercer Rubber Company or stainless steel equal to Vibraflexor as manufactured by Atlantic Metal Hose Company, Allied Metal Hose Company or Universal Oil Products Flexonics Division as shown or noted on the Drawings.

JOINT RESTRAINT
Where water or air pressure exert a disjointing force, all pipe deflections over 20 degrees, all tees and plugs, joints shall be restrained, tied or harnessed in a manner acceptable to the Engineer. The restraint shall be applied to joints each way an adequate distance to resist the axial thrust of the test pressure. Details of all proposed joint restraint, showing the type and locations, shall be submitted to the Engineer for approval. Concrete thrust blocks will not be permitted. All joint restraint shall be considered incidental to this section of the work.

Acceptable methods of joint restraint:

Cast Iron Pipe: Retainer glands thru 12-inch pipe and Super-Lock or Lockfast above 12-inch pipe.

Concrete Pipe: Lugs and draw bolts (Draw bolts galvanized), or Bell Bolts or harness clamps.

Ductile Iron Pipe: Retainer glands thru 24-inch pipe and Super-Lock or Lockfast above 24-inch pipe.

Steel Pipe: Studs and lugs AWWA Manual M11 (studs galvanized).

Where internal joint locking devices are used, the pipe thickness shall be increased equal to the locking groove depth. Specified pipe class thickness shall be maintained over the entire pipe length.

JOINT HARNESSING
Pipe and fittings that require harnessing shall be provided with standard lugs ASTM A283, Grade B or A285 Grade C, or equal meeting the requirements of AWWA Specification C100 or AWWA Manual MII, unless otherwise noted. Harness tie rods and nuts shall be mild steel meeting the requirements of ASTM A 193 Grade B7 or A 307, Grade B, or equal with American Standard threads. The nuts shall seat on steel plate washers. The rod, washers and nuts shall be hot dipped galvanized ASTM A-153.

HANGERS AND SUPPORTS
Hangers and supports shall include all hanging and supporting devices of metallic construction shown, specified, or required for piping, apparatus, and equipment installed under this section of the work.

All supports and parts shall conform to the latest requirements of ASA B31.1 except as supplemented or modified by the requirements of this specification or as detailed on the Drawings. Materials shall include stainless steel, galvanized steel, galvanized malleable iron and wrought iron.

Hangers and supports shall be adequate to maintain the pipelines, apparatus, and equipment in proper position and alignment under all operating conditions with due allowance for expansion and contraction, and shall have springs where necessary. Hangers and supports shall be of standard design where possible equal to those manufactured by Grinnell or Elcen and be best suited for the service required, as approved by the Engineer.

Supporting devices shall be designed in accordance with the best practice and shall not be unnecessarily heavy. Sufficient hangers and supports shall be installed to provide a working safety factor of not less than 5 for each hanger. Hangers shall have a minimum spacing in accordance with ASA B31.1.

Point loading hangers are not acceptable. Hangers shall be sling or saddle type.

Wherever possible, pipe attachments for horizontal piping shall be pipe clamp and structural attachments shall be beam clamps.

All rigid hangers shall provide a means of vertical adjustment after erection.

Generally hangers shall be sized for supporting the pipe, excluding insulation.

On pipes which are covered with insulation where hangers and supports are outside the insulation proper pipe protection saddles shall be installed.

Overhead hangers shall be supported by threaded rods properly fastened in place by suitable screws, clamps, inserts, or bolts, or by welding.

Saddle stands shall be of the adjustable type. Each stand shall consist of a length of steel pipe fitted at the base with a standard threaded flange and at the top with an adjustable saddle or roll. The base flange shall be bolted to the floor, foundation or concrete base.

Anchors shall be furnished and installed when specified, shown, or equired for holding the pipelines and equipment in position or alignment. Anchors shall be designed for rigid fastening to the structures, either directly or through brackets. The design of all anchors shall be subject to approval by the Engineer. Materials shall be galvanized or stainless steel.

Inserts for concrete shall be galvanized or stainless steel or galvanized malleable iron and shall be installed in the concrete structures where required for fastening supporting devices. They shall be designed to permit the rods to be adjusted horizontally in one plane and to lock the rod nut or head automatically. Inserts shall be recessed near the upper flange to receive reinforcing rods. Inserts shall be so designed that they may be held in position during concrete pouring operations. Inserts shall be designed to carry safely the maximum load that can be imposed by the rod which they engage.

Concrete supports shall be placed wherever shown or required under Concrete Work.

Equipment shall be supported in accordance with manufacturer's recommendations.

The Contractor shall coordinate his work with the Finish Contractor to insure that all pipe under all hanger and supporting devices has been painted.

CLEANOUTS

Cleanouts shall be provided where shwon or specified. Cleanout openings for pipe 8-inches or larger in diameter shall be not less than 6-inches in diameter (unless otherwise noted on the Drawings). Cleanout openings for pipe 6-inches and smaller shall be of the same diameter as the pipe. Cleanout covers shall be standard 125-pound blind flanges, where conformation is required with the inside curvature of the pipeline, in which case the covers shall be flanged of proper shape with standard flange drilling. Covers shall be fastened by means of galvanized steel studs and nuts and shall be drilled and tapped for a 1½-inch pipe connection. A 1½-inch galvanized steel plug shall be furnished. The flange or conformed plugs shall be provided with a dowel or other suitable means in order to assure proper setting.

TAPS AND PLUGS

Where indicated or required, pipe or fittings shall be tapped to receive small pipe or special fittings under this or other headings of the work. Required taps shall be furnished as part of this work. All taps will be temporarily plugged at point of fabrication.

CONNECTIONS TO EXISTING FACILITIES

The Contractor shall furnish all labor and materials required for the connection of piping under this contract to existing structures as called for on the Drawings.

When breaking holes for connections to existing structures, care shall be taken to prevent debris from entering. After installation of the pipe, the structure shall be pointed up around the pipe, both on the inside and outside so that it is restored to a watertight condition.

TESTS

General. After completion, each run of pipe shall be tested by the Contractor in the presence of the Engineer. Any leaks shall be made tight.

Under this work the Contractor shall furnish all water or air, piping, bulkheads, pumps or compressors, gauges, and other equipment required to carry out the test.

The section of pipe to be tested shall be cleaned and isolated by valves or plugs. Such valves or plugs shall be designed to hold against the test pressure. Sections of pipe shall have an opening through which air or water can be introduced. The supply line shall be fitted with suitable control valves and a pressure gauge for continually measuring the pressure. The pressure gauge shall have a minimum diameter of 3½-inches and a range compatible with the test pressure.

Pipe lines which cannot be closed for a direct pressure test shall be tested by filling the tanks to which they connect to the highest operating level or installing temporary test bulkheads. After completion of tests, all pipes shall be drained. Buried pipe lines shall be pressure tested with all pipe joints exposed for visual inspection unless otherwise directed by the Engineer.

If requested by the Engineer, the Contractor shall furnish proposed test procedures for approval including pipe identification, test pressure and a description of the method of testing.

In the event that the leakage exceeds the specified amount, the joints in the line shall be carefully inspected for leaks and recaulked or repaired where necessary. Any pipes or special castings found to be cracked shall be removed and replaced with new pieces by the Contractor. After this work has been done, the test shall be repeated. Final acceptance of the lines will not be made until satisfactory tests have been passed.

Test Pressures. In general, pipe lines shall be tested at 1½ times their working pressure or as indicated for the following conditions whichever is greater:

Wash Water Drain	25 psig
Pump Discharge	100 psig
Service Water	100 psig

Hydrostatic Testing. The section of pipe to be tested shall be filled with water and the entrained air within the line removed, and pumped up to test pressure and the test period shall start immediately thereafter.

The line shall be maintained under the test pressure for a continuous four (4) hour period. The leakage per hour under the conditions of test shall not exceed the values shown in the following table or shall hold the pressure with no more than a 10% loss in pressure over the entire period.

Size of Pipe (Inches)	Maximum Leakage Gallons Per Hour per 100 Joints
4	1.08
6	1.62
8	2.16
10	2.70
12	3.24
14	3.78
16	4.32
18	4.86
20	5.40
24	6.48
30	8.10
36	9.72
42	11.34

Pneumatic Testing. The section of pipe to be tested shall be filled with air and pumped up to test pressure. Sufficient time shall be allowed for the air pressure to stabilize at the test pressure. After the stabilization period, the air control valve shall be closed and the test period started.

The section of pipe shall be maintained under the test pressure for a continuous four (4) hour period with no more than a 10% loss in pressure over the entire test period.

Sterilization of Potable Water Piping. After each potable water line has been completed and tested it shall be filled with the chlorinated water (80 parts per million of chlorine). A contact period of six to eight hours shall be allowed after which the pipe shall be flushed with water from the distribution system until the chlorine residual in the pipe line is 0.5 ppm. The pipe shall then be allowed to stand for a 24-hour period. At the end of this period samples shall be drawn from each run of piping for bacteriological analysis. If these analyses show the presence of harmful bacteria, the Contractor shall repeat the sterilization process until such time as the pipe lines are shown to be sterile by the results of the bacteriological analysis.

The Contractor shall furnish the necessary labor, chlorine and chlorine solution feeding equipment required. The City will furnish the water for filling pipe lines. The Contractor shall make suitable arrangements with the Owner for the bacteriological analyses.

WALL AND SLAB SLEEVES AND CASTINGS

At all points where pipes must pass through the walls or floors of structures, the Contractor shall furnish and install suitable sleeves or wall castings. Unless otherwise shown or permitted, the space between the pipe and the sleeve shall be caulked with lead and oakum as specified under Bell and Spigot Lead or sealed with a rubber seal.

Rubber link seal shall be identical rubber links interconnected with bolts and elongated nuts and washers. The sealing element shall be made of synthetic rubber material especially compounded to resist aging, ozone, sunlight and chemical action. Bolts and metal parts shall be made of galvanized or cadmium plated steel to resist corrosion. Rubber link seal joints shall be submitted to the Engineer for approval.

Unless specifically shown or noted to the contrary on the Drawings, all sleeve and casting openings in existing walls and slabs, and repair thereof, shall be accomplished under this work.

Under this section of the work all required sleeves and castings shall be set and secured in proper alignment.

In general, the wall sleeve or castings shall be of the same material as the pipe. Iron pipe wall castings, wall pipe, transition sleeves and solid sleeves shall meet the requirements of AWWA Specifications C100 and shall be of the lightest class conforming to the pressure rating of the pipelines which they connect, but in no case shall be lighter than Class B.

Steel sleeves and wall pipe shall not be painted in areas to be embedded in the concrete. Under this section of work all loose rust, scale, grease or oil shall be removed prior to pouring of the concrete.

Where watertightness is essential and at other locations where indicated, wall castings and sleeves shall be provided with an intermediate flange located approximately at the center of the wall.

GENERAL

All joint materials and lubricants shall be furnished with the pipe, including all joint material required for connection to equipment furnished under other sections of the work.

All joint materials shall be assembled in accordance with standard practice and the manufacturer's recommendations.

All equipment connections shall be flanged, union or grooved coupling so that equipment can be removed without disassembly of the connecting piping.

BOLTED FLEXIBLE COUPLINGS (BFC)

Bolted flexible couplings shall consist of a steel sleeve, with centering bead removed, rubber gaskets, follower rings and a full complement of nuts and bolts. Couplings shall allow a deflection of approximately 4 degrees per joint. Couplings shall be equal to Style 38 for steel pipe and Style 53 for cast iron pipe, as manufactured by Dresser Industries, Inc., style 411 for steel pipe and style 431 or 441 for cast iron pipe, as manufactured by Rockwell, or equal.

Couplings shall have a minimum middle ring thickness and minimum length as follows:

Pipe Size (inches)	Middle Ring Thickness	Middle Ring Length
6-in. and less	1/4-inch	5-inch
8-in.-12-in.	1/4-inch	7-inch
14-in.-20-in.	5/16-inch	7-inch
24-inch	3/8-inch	7-inch
30-in.-48-in.	3/8-inch	10-inch

Couplings and accessories shall be galvanized and shall be shop coated with a sealer suitable for subsequent field painting or coating.

All bolted flexible couplings shall be harnessed with tie bolts or studs across the joint, design based on test pressures. On cast iron or ductile iron pipe tie bolts shall be installed between flanges across the coupling unless otherwise noted on the drawings or approved by the Engineer. Piping of other materials shall be furnished with lugs. The number and size of the bolts in studs and other details of the harnessed joint shall be furnished the Engineer for approval. Tie bolts or studs shall be galvanized.

Ground ground buried joints shall be thoroughly cleaned, dried, primed and coated with one of the following coatings in accordance with AWWA C-203 or C-209.

Hot Coal Tar Enamel. A canvas diaper shall be fitted around the joint and tightly secured in place with metal straps. Hot coal tar enamel at a temperature of 450°F to 490°F shall be poured over the joint and into the diaper until the joint is completely coated. The diaper shall be of sufficient width to insure coating of the entire joint and uncoated pipe ends. Coating of joints shall be in accordance with the manufacturer's recommendations.

Hot Applied Tape. A hot applied coating tape consisting of a high tensile strength fabric completely saturated with a coal tar pitch, which provides a compatible base for the bonding of a pliable coal tar coating to both sides of the carrier, and with a tough polyester film overwrap. Installation, including the primer application, shall be in accordance with the manufacturer's recommendations.

BELL AND SPIGOT CONCRETE (BSC)

Concrete bell and spigot (tongue and groove) joints shall be AWWA C302 or ASTM 361, concrete, with rubber "O" ring gasket (ASTM C443) fitting into a gasket groove, or approved equal.

BELL AND SPIGOT LEAD (BSL)

Bell and spigot lead joints shall meet the requirements of ASA A21.10 and installed as shown or noted on the Drawings and approved by the Engineer.

The joint shall be made with packing and soft pig lead, except for inverted joints or joints made under water, where lead wool shall be used. The packing shall be loosely twisted in one piece for each joint and shall be thoroughly driven into the bell so that the lead, after having been caulked, shall have a depth of at least 2-inches for pipe 14 inches or less in diameter and 2½-inches for pipe more than 14-inches in diameter. Each lead joint shall be made at one pouring. The furnace and melting pot shall be kept near the joint to be poured. Dross shall not be allowed to accumulate in the melting pot. The joints shall be thoroughly caulked by competent mechanics in a manner which will insure tight joints without overstraining the iron of the bells. On pump discharge lines or where shown on the drawings or otherwise required, bolted steel shackles shall be provided across joints to resist movement due to internal pressures.

On steel pipe, steel caulking rings shall be welded to the pipe, for use at leaded joints.

Lead for cast-iron pipe joints shall be soft and malleable and shall meet the requirements of Federal Specification QQ-L-156 Type I. Lead Wool shall meet the requirements of Federal Specification QQ-L-156 Type II. Packing for lead joints, other than potable waterlines, shall be the best quality hemp yarn or jute, closely twisted in one piece for each joint. Packing for potable waterlines shall be pre-molded rubber rings, asbestos rope, treated paper rope, or sterilized fiber, approved by the Engineer.

BELL AND SPIGOT STEEL (BSS)
Steel bell and spigot joint materials and manufacture shall be in accordance with AWWA Standard C301, C302 steel for concrete pipe and AWWA Standard C201 or C202 for steel pipe. Each joint shall have a rubber O-Ring gasket meeting the requirements of AWWA C302.

When ground buried concrete pipe have been joined, a band at least five and one-half inches wide shall be placed around the outside of the pipe at the joint as recommended by the pipe manufacturer. This band shall serve as a form for placing a 1:2 cement mortar grout in the external recess formed by the face of the bell and the shoulder of the spigot. If the air temperature is below 40°F. The spigot, bell and mortar shall be heated. If a reinforced paper joint band is used, it shall be drawn up tight around the pipe and the backfill tamped against it up to the springline before pouring the grout or enamel. If a cloth band is used, it shall be wired around the outside of the pipe and the grout poured before backfilling. As a substitute for the concrete band, prefabricated joint protectors may be used. They shall be made from a high density polyether, polyurethane foam containing at least the equivalent of 9 bags per cubic yard of unhydrated portland cement. The protectors shall be of suitable cross-section to fully protect the joint rings and shall be supplied in the form of continuous rings.

Exterior ground buried joints on steel pipe shall be thoroughly cleaned, dried and coated with one of the following coatings in accordance with AWWA C-203 or C-209.

Hot Coal Tar Enamel. A canvas diaper shall be fitted around the joint and tightly secured in place with metal straps. Hot coal tar enamel at a temperature of 450°F to 490°F shall be poured over the joint and into the diaper until the joint is completely coated. The diaper shall be of sufficient width to insure coating of the entire joint and uncoated pipe ends. Coating of joints shall be in accordance with the manufacturer's recommendations.

Hot-Applied Tape. A hot applied coating tape consisting of a high tensile strength fabric completely saturated with a coal tar pitch, which provides a compatible base for the bonding of a pliable coal tar coating to both sides of the carrier, and with a tough polyester film overwrap. Installation, including the primer application, shall be in accordance with the manufacturer's recommendations.

The annular inside and angular space between concrete pipe joints on all but treated potable water lines shall be completely filled with preformed, cold-applied, ready-to-use plastic joint sealing compound and primer approved by the Engineer or joint mortar pointed. Excess joint material shall be trimmed smooth on the inside of the pipe. Potable water lines shall be joint mortar pointed.

Where shown on the Drawings or listed in the Schedule, bolted steel shackles shall be provided across joints. All bolting materials shall be galvanized.

Wherever specified each pipe shall be bonded to the next pipe across the joint by spot welding on insulated No. 4 RR direct burial cable to the steel of the bell and spigot.

FLANGED JOINTS (FJ)
Pipe flanges shall conform to American Standard: dimensions, ASA B16.1 and threads, ASA B2.1. Flange faces except stainless steel shall be coated with a rust inhibitor immediately after drilling.

Flanges for cast-iron pipe and fittings shall meet the requirements of the current ASA 125 Standard.

Flanges for steel plate pipe and fittings shall meet the requirements of AWWA C207 Standard Steel Ring Flanges, Class B, except high service discharge piping as noted on the drawings or in the Schedule shall be Class D.

Flanges for stainless steel pipe shall be fabricated from stainless steel flat plate of the same composition as the pipe.

Flanged joints shall be made up with full face 1/16-inch rubber gaskets, or stiff ring gaskets of asbestos fiber of thickness and type to be approved by the Engineer. Gaskets for gas lines shall be neoprene and asbestos.

Flanges shall be firmly bolted with machine, stud or tap bolts of the proper size and number meeting the requirements of ASTM A307 Grade B. Joints made with bolts or bolt studs shall have a nut on each side. Bolt projection through nuts shall be equal and where studs are used bolt projection on each side of the flange shall be equal.

All nuts and bolts shall be hot-dipped galvanized except on stainless steel flanges shall be 316 L stainless steel.

Flange connections to all flexible connectors and expansion joints shall have galvanized lock washer under all nut and bolt heads and include two control rods across each joint.

Flanged joints shall not be used on ground buried pipe.

GROOVED COUPLINGS (GC)
Rigid grooved couplings where shown or noted on the Drawings, or noted in the Pipe Schedule shall be furnished. Flexible type will only be used in applications approved by the Engineer. Grooved couplings and fittings may be used in lieu of flanged joints.

Couplings shall have housings fabricated in two or more parts of malleable iron in accordance with ASTM Specification A47 Grade C32510. Bolts shall be oval neck track head type with hexagonal heavy nuts, per ASTM A-183 and A-194. Gasket material shall be Grade "H", "E" chlorinated butyle or E.P.D.M. for water service and grade "T" Buna-N for sewage.

Cast iron grooved ends sizes 3-inch - 24-inch shall conform to the requirements of USAS B16.1 USA Standard for cast iron pipe flanges and fittings for 125 pound service for all dimensions with the exception of end preparation. The ends shall be grooved in accordance with manufacturer's standard groove dimensions. Malleable iron fillings ASTM A-47 and ductile iron fittings ASTM A-536 shall be of grooved or shouldered end design to accept grooved mechanical couplings without field preparation.

Steel pipe Schedule 40 or better may be cut grooved in accordance with manufacturer's standard groove dimensions. Where pipe is less than Schedule 40 or standard weight, a ring shall be welded to steel pipe to form the necessary shoulder for the joint or the pipe may be roll-grooved in accordance with manufacturer's recommendation for roll-grooving pipe as approved by the Engineer.

All cast iron pipe in sizes 4-inch - 24-inch shall be radius cut grooved in accordance with manufacturer's specifications.

MECHANICAL JOINTS (MJ)
Mechanical joints shall conform to ASA A-21.10 and A-21.11 and AWWA C110 and C111. Each joint shall be complete with rubber gasket, cast iron gland and a full complement of cast-iron bolts and nuts.

PUSH-ON JOINT (POJ)
Where shown or noted on the Drawings rubber gasket type push-on or slip-on joints of approved manufacturer (Bell-Tite, Ring-Tite, Tyton, Fastite, or equal) will be allowed as approved by the Engineer. Joints shall conform to ASA A21.11 and AWWA C111. Push-on joints will generally be used on all ground buried cast-iron, ductile iron or PVC pipe.

SCREWED JOINTS (SJ)
Screwed joints in steel plate, or black steel pipe shall conform to American Standards; dimensions, ASA B16.3 threads, ASA B2.1.

The ends of pipe shall be reamed and all burrs and cuttings shall be removed. Joints shall be screwed up using white or red lead, teflon thread type or an approved compound.

SOCKET TYPE JOINT (STJ)
Plastic pipe joints shall be solvent cemented socket-type meeting the requirements of ASTM D-1785 and D-2467, schedule 80, and fiberglass reinforced pipe joints shall be adhesive bell and spigot type as approved by the Engineer.

WELDED JOINT (WJ)
Butt-welded joints shall be used whenever shown or noted on the Drawings. Welding shall comply with the current AWWA Standard C206. Lap-welded joints may be used if approved by the Engineer.

PIPING

PIPING USES

In general, sewage/water lines inside the building or exposed piping on top of tanks smaller than 16-inches in diameter, shall be cast iron and if 16-inches or greater in diameter, shall be steel. Ground buried pipe lines outside of buildings, shall be ductile iron if less than 16-inches in diameter and concrete pressure pipe or steel pipe if 16-inches or greater in diameter, except as noted on the Drawings or in the Schedule.

Natural gas and sewage gas shall be Black Steel Pipe (BSP).

PROCESS PIPING

BLACK STEEL PIPE (BSP)
Black steel pipe shall meet the requirements of ASTM A53 Schedule 80.

Fittings. Fittings shall be welded conforming to ASA B16.9, ASTM A234 WPA-Grade, equal in thickness to the pipe.

Coating and Lining. Inside lining on all pipe and outside coating on exposed pipe is not required. Ground buried black steel pipe and fittings shall be coated on the outside with a cold-applied wax coating.

Joints. Black steel pipe joints shall be welded with flange connections where required for connection to equipment in accordance with the paragraph on Pipe Joints, as shown or noted on the Drawings, listed in the Schedule and approved by the Engineer.

CAST IRON PIPE (CIP)
Cast-iron pipe shall be designed and fabricated in accordance with these specifications and as shown or noted on the Drawings.

Cast-iron pipe shall meet the requirements of AWWA C106 or C108 (ASA A21.6 or A21.8), pipe barrel thickness shall meet the requirements of AWWA H1 (USAS A21.1) for 150 psi internal pressure, and iron strengths of 21,000 psi tensile strength and a 45,000 psi ring modulus of rupture. Pipe placed in buildings shall have a minimum thickness of Class 22. For pipe buried in the ground, the minimum thickness shall be for laying condition B for the maximum indicated depth of cover, but in no case shall it be less than Class 22. Each pipe run shall be of the same class. Pipe sizes indicated are inside diameter (I.D.).

Fittings. Cast-iron fittings shall meet the requirements of AWWA C110 (ASA A21.10), pressure rating 250 psi for 12-inch and less pipe, and 150 psi for pipe over 12-inches in diameter.

Coatings and Linings. Ground buried cast-iron pipe and fittings, at the point of fabrication, shall be coated on the outside with a bituminous coating of coal tar varnish or asphalt base paint, one mil thick in accordance with ASA A21.6 or ASA A21.8 and cement lined, standard

thickness, in accordance with AWWA C104 (ASA A21.4).

Exposed pipe and fittings, at the point of fabrication, shall be coated on the outside with a universal rust-inhibitive primer 1.5 - 2.0 mils dry thickness and cement lined as above.

Joints. Cast-iron pipe joints shall be, mechanical, bell and spigot lead, flanged, bolted flexible coupling and push-on, in accordance with the paragraph on Pipe Joints, as shown or noted on the Drawings, listed in the Schedule, and approved by the Engineer.

Installation. Cast-iron pipe shall be installed as outlined in the paragraph on Piping Installation and in accordance with "A Guide for Installation of Cast Iron Water Mains" Published by the Cast Iron Pipe Research Association and AWWA C600.

DUCTILE IRON PIPE (DIP)

Ductile iron pipe shall be designed and fabricated in accordance with these specifications and as shown or noted on the Drawings.

Ductile Iron Pipe. Ductile iron pipe shall conform to the requirements of ASA A21.51 (AWWA C151) and ASTM A-536 Grade 60-45-10. The pipe wall thickness shall be Class 3 pipe for sizes less than 24-inches and Class 4 for pipe sizes 24-inches and larger.

Fittings. Ductile iron fittings shall meet the requirements of ASA A21.10, pressure rating 250 psi cast iron for 12-inches and less pipe, and 150 psi cast iron or 250 psi ductile iron for pipe over 12-inches in diameter.

Coatings and Linings. Ground buried ductile iron pipe and fittings at the point of fabrication shall be exterior coated with a bituminous coating of coal tar varnish or asphalt base paint, one mil thick, in accordance with ASA A21.51 and cement lined, standard thickness, in accordance with ASA A21.14 (AWWA C104).

Exposed pipe and fittings, at the point of fabrication, shall be coated on the outside with an universal rust-inhibitive primer 1.5 - 2.0 mils dry thickness and cement lined as above.

Joints. Ductile iron joints shall be bell and spigot lead, flanged, mechanical, bolted flexible coupling, grooved coupling and push-on, as specified under Pipe Joints as shown or noted on the Drawings listed in the Schedule and approved by the Engineer.

PRESTRESSED CONCRETE CYLINDER PIPE (PCCP)

Prestressed concrete cylinder pipe shall be designed and fabricated in accordance with these specifications and as shown or noted on the Drawings.

Installation shall be in accordance with AWWA Manual M9, Installation of Concrete Pipe, pipe manufacturers recommendations and these specifications.

Prestressed concrete cylinder pipe shall meet the requirements of AWWA C301 and shall be designed, unless otherwise shown or noted on the Drawings and/or listed in the Schedule, for an internal pressure of 25 psi, and external loadings shown on the drawings. Pipe sizes indicated are inside diameter (I.D.).

Where noted on the Drawings or listed in the Schedule subaqueous pipe shall be furnished.

Fittings and Specials. Fittings and specials shall be of the same construction and design as the pipe.

Joints. Joints shall be bell and spigot steel as described hereinbefore under Pipe Joints. Special joints will be furnished as shown or noted on the Drawings and/or listed in the Schedule.

Coatings and Linings. No special coatings or lining required.

REINFORCED CONCRETE PRESSURE PIPE (RCPP)

Reinforced concrete pressure pipe shall be designed and fabricated in accordance with these specifications and as shown or noted on the Drawings.

Installation shall be in accordance with AWWA Manual M9, Installation of Concrete Pipe, and these specifications.

Reinforced concrete pressure pipe shall meet the requirements of ASTM C361 and shall be designed, unless otherwise shown or noted on the Drawings and/or listed in the Schedule, for an internal hydrostatic pressure of 75 feet and external loadings shown on the Drawings. Pipe sizes indicated are inside diameter (I.D.).

Where noted on the Drawings or shown in the Schedule, subaqueous pipe shall be furnished.

Fittings and Specials. Fittings and specials shall be of the same construction and class as the pipe.

Joints. Joints shall be bell and spigot steel in accordance with the paragraph on Pipe Joints, as shown or noted on the Drawings, listed in the Schedule and approved by the Engineer.

Coatings and Linings. No special coating or lining required.

STEEL PLATE PIPE (SPP).
Steel plate pipe shall be designed, fabricated, and installed in accordance with these specifications, AWWA Manual on Steel Pipe - Design and Installation MII, and as shown or noted on the Drawings.

Steel pipe plates shall meet the requirements of ASTM A-134 with steel plates meeting the requirements of ASTM A-283, Grade B or ASTM A-139, Grade B, spirally welded, straight seam or seamless equal to Armco or U.S. Steel welded steel pipe.

Steel plate pipe shall conform to the requirements of AWWA C201 and C202.

In general, standard lengths of 40 feet shall be furnished except where shorter lengths are necessary for installation as shown or noted on the Drawings and approved by the Engineer.

Fittings. Fittings shall meet the requirements of AWWA C-208. All fittings in buildings shall be Table I and all buried fittings shall be Table II. Welded fittings shall be equal in thickness to the pipe.

Specials. Specials shall be fabricated of steel plate and designed for the same conditions as the pipe. Collars, stiffeners, and other reinforcement shall be used as required to obtain the necessary strength in all parts of the special. A plate collar shall be welded around all outlet connections.

Coatings and Linings. All steel plate pipe, fittings and specials shall receive a shop application of the coating and lining as herein specified or as shown or noted on the Drawings.

Coating and lining for all steel air piping shall be galvanized in accordance with ASTM A-153.

Interior linings for other steel pipe shall meet the requirements of AWWA C-203 for hot coal-tar enamel, except for high service discharge piping and as noted on the Drawings. High service discharge piping as noted on the Drawings shall be shop lined on the inside with centrifugally spun cement mortar lining 5/16-inch thick for 16-23-inch pipe, 3/8-inch thick for 24-36 inch pipe and 1/2-inch thick for over 36-inch pipe. Mortar linings shall be in accordance with AWWA Standards C-205 and C-602 latest revisions.

Exterior coatings for all steel pipe shall meet the following requirements:

Ground buried pipe after sand blasing (commercial blast) or grit blasting, dried and primed shall receive one of the following coatings meeting the requirements of AWWA C-203:

Hot Coal Tar Enamel. Coal tar enamel coating, asbestos felt wrap, water-resistant white wash and kraft paper wrap.

Hot Applied Tape. A hot applied coating tape consisting of a high tensile strength fabric completely saturated with a coal tar pitch, which provides a compatible base for the bonding of a pliable coal tar coating to both sides of the carrier, and with a tough polyester film overwrap. Installation, including the primer application, shall be in accordance with the manufacturer's recommendations. Factory applied tape shall be covered with asbestos felt wrap, water-resistant white wash and kraft paper wrap.

Ground buried galvanized air piping shall receive the same exterior coating as specified above except in lieu of sand blasting a chemical cleaner followed by a sealer coat (metal conditioner) shall be applied prior to the primer.

Exposed pipe, other than galvanized pipe, shall be sand blasted clean (commercial blast) and primed meeting the requirements of AWWA C-203. Under this division of the work the Contractor shall coordinate the painting requirements to insure compatibility with finish painting as specified under Finishes.

Repair. Repair of all damaged interior pipe coatings, ground buried exterior pipe coatings and galvanized coatings shall be under this division of the work. Repair of exposed painted pipe shall be under Finishes.

For bolted flexible couplings buried in the ground, the outside coating shall be left off the pipe for a distance of 8-inches from each end. These areas shall be shop primed. After complete installation of the pipe and coupling, the uncoated portions of the outside of the pipe and the outside of the coupling shall be thoroughly cleaned, primed, and given a field coating of the same material as specified for the pipe.

For welded joints, both inside and outside coatings shall be left off for a distance of 6-inches from each end. These areas shall be shop primed. After completing the welded joint and under this section of the work, the interior of all joints and exterior of ground buried pipe shall be thoroughly cleaned, primed, and given field coating of the same material as specified for the pipe. Coating shall meet the requirements of AWWA C-203, as approved by the Engineer. Exposed field welded joints shall be cleaned under this division of the work to remove slag and scale, and then shall be finish cleaned, primed and painted under Finishes.

Damaged linings, coatings and wrappings shall be repaired under this division of the work and, if possible, before pipe is laid, Surfaces shall be thoroughly cleaned, dried and free of old materials. They shall then be given

a field coating of the same material as specified for the pipe. Coating shall meet the requirements of AWWA C-203, as approved by the Engineer.

Joints. Steel plate pipe joints shall be bell and spigot steel, flanged, bolted flexible coupling, grooved coupling, screwed or welded, in accordance with the paragraph on Pipe Joints, as shown or noted on the Drawings, listed in the Schedule, and approved by the Engineer.

Taps. Pipe taps in steel pipe lines shall include a steel 3000-pound coupling fitting welded into the wall of the pipe and threaded to receive small piping, special fittings, or corporation stops of a size and location as noted or shown on the Drawings.

Pipe Thickness. Nominal pipe size indicated for pipe less than 14-inch shall be inside diameter (I.D.) and pipe 14-inch and larger shall be outside diameter (O.D.).

Pipe shall be fabricated meeting special design conditions as shown or noted on the Drawings and/or listed in the Piping Schedule with the minimum thickness as given in the following table.

Pipe Size	Buried in Earth	Exposed
Less than 15-inch	.188	.135
15-28-inch	.250	.188
30-40 inch	.312	.250
42-51 inch	.375	.313
54-66 inch	.438	.375

PIPE WORK SCHEDULE KEY

GENERAL

The following pipe schedule gives the designation for each pipe line, pipe size, joint, material, service and other pertinent data.

The key of symbols for the Schedule is as follows:

SCHEDULE KEY

PIPING MATERIAL

PROCESS PIPING

BSP	-	Black Steel Pipe
CIP	-	Cast Iron Pipe
CSIP	-	Chrome Silicon Iron Pipe
DIP	-	Ductile Iron Pipe
FRP	-	Fiberglass Reinforced Pipe
GSP	-	Galvanized Steel Pipe
HDP	-	High Density Polyethylene
PVC	-	Plastic Pipe
PCCP	-	Prestressed Concrete Cylinder Pipe
RCPP	-	Reinforced Concrete Pressure P Pipe
SSP	-	Stainless Steel Pipe
SPP	-	Steel Plate Pipe

PIPE JOINTS

BFC	-	Bolted Flexible Coupling
BSC	-	Bell and Spigot Concrete
BSL	-	Bell and Spigot Lead
BSS	-	Bell and Spigot Steel
FJ	-	Flanged
GC	-	Grooved Couplings
MJ	-	Mechanical Joint
POJ	-	Push-on Joint
SJ	-	Screwed Joints
STJ	-	Socket Type Joint
WJ	-	Welded Joint
FWJ	-	Field Welded Joint

REMARKS

CL	-	Class

PIPING SCHEDULE

No.	Size	Joints	Material	Service	From	To	Buried or Exposed
1	36-inch	MJ*, BFC	CIP/DIP	Wash Water Drain	East end Ex. Filter Bldg.	Wash Water Retention Basin	Buried
1a	36-inch	F	SPP	Wash Water Drain	Valve Chamber		Exposed
2	36 inch	MJ	CIP/DIP	Wash Water Reten-tention Basin Overflow	Overflow Chamber at Wash Water Retention Basin	Headwall No. 1	Buried
3	12-inch	Exposed, F, BFC Buried: MJ	CIP/DIP	Wash Water Return	Pump Room at Wash Water Retention Basin	Ex. East Plant Control Building and Ex. North Gallery	Buried and Exposed

* The existing 36-inch tee at the east end of the existing Filter Building is a Class CIP tee with AWWA Plug.

9. VALVES AND GATES
GENERAL

SCOPE OF WORK
This work shall be subject to the conditions of the General Requirements and include the furnishing of equipment accessories and services necessary for providing the items as shown on the Contract Drawings and/or as herein required.

Equipment furnished under this section shall be fabricated, assembled, and placed in proper operating conditions in full conformity with detail drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer as approved by the Engineer. Special attention shall be given to the General Equipment Stipulations of the General Requirements.

Work Included. This work shall include the furnishing of all sluice gates, slide gates, and valves, 4-inches in diameter and larger as shown on the Drawings, as listed on the Schedule, and as specified hereinafter.

All valves and gates shall be of new construction and complete with their operating equipment and other appurtenances necessary for operation. Accessories shall include wall thimbles, anchor bolts, operating stems, stem guides, operators, and floor boxes, bench stands, or floor stands properly designed to operate the valves or gages furnished and installed.

Work Not Included. In general, unless noted otherwise on the Drawings or in these specifications, all valves and gates smaller than 4-inches will be furnished under the Plumbing, Process Piping and HVAC section of the work.

Wiring to motor operators and limit switches will be done under Electrical.

Items furnished under this section shall be erected under Pipe Work. Hanger rods, inserts and supports, flange bolts, and gaskets for valves will be furnished and installed under Pipe Work.

Related Work By Others

Section	6 - Finishes
Section	8 - Pipe Work
Section	12 - Plumbing, and HVAC
Section	13 - Electrical

INSTALLATION
Special attention shall be given by the Contractor to insure that items furnished under this section of the work are installed in accordance with manufacturers recommendations.

VALVE AND GATE IDENTIFICATION
All valves and gates shall be tagged with it's distinguishing mark letter and number. Mark letter and number will be as listed in the Schedule. Identification tag shall be 1½-inch in diameter 18-gauge polished brass or aluminum with ½-inch high, embossed, black-filled mark letter and number placed thereon. Tags shall be securely fastened to the valve or gate operator with No. 16 brass jack chain or plastic seals.

SHOP PAINTING
For shop painting requirements refer to the General Equipment Stipulations of the General Requirements.

SHOP DRAWINGS AND GUARANTEES
Furnish, as prescribed under the General Requirements, Shop Drawings and Guarantees covering the items included under this section of the Contract.

Each valve and gate including accessories shall be identified on the Shop Drawings by its respective mark as noted on the Valve and Gate Schedule.

BUTTERFLY VALVES (B)
All butterfly valves shall conform to the latest AWWA Specification C-504, except as hereinafter specified.

Valve body shall be cast iron ASTM A126 Class B. Disc shall be cast iron ASTM A-48 Class 40, ductile iron ASTM A-536 Class 65-45-12, ni-resist ASTM A-436 Type 1 of aluminum bronze ASTM B148 CL9A. Corrosion resistant edge material shall be furnished on all cast iron or ductile iron disks. Shaft seal shall be adjustable chevron packing or "O" ring. Shaft shall be stainless steel and the seat shall be Buna N or EPDM for water service, Buna N for sewage and Neoprene, Buna N or EPDM for air.

Valves shall be suitable for throttling service through the entire range of flow - open to closed.

The flanged, face-to-face dimension for Class 25, 75 and 150 valves shall be short body laying length as specified under AWWA C-504, Table 2 unless otherwise noted.

Butterfly valves for ground-buried service shall be furnished with mechanical joint ends, with extension bonnet and valve operator as specified in the Valve Schedule. They shall be provided with non-adjustable chevron packing.

Valves generally shall be mounted with the shaft horizontal.

The minimum valve body shell thickness for Class 25, 75 and 150 valves shall be as specified under AWWA C-504, Table 2.

Valves shall be the product of one of the following manufacturers, or equal:

Allis-Chalmers	Kennedy Valve
BIF	Henry Pratt
Dresser	

CHECK VALVES

Standard Check Valves (C). In quality of material and workmanship, check valves shall fulfill the requirements of the specification set forth above for gate valves insofar as they are applicable to the construction of check valves. Check valves shall be cast iron body and fully bronze mounted with an elastomer seating ring. Check valves shall be of the balanced single disc type with the disc hinged at the top, with outside lever and adjustable weight or spring. A clear waterway opening equal to the full area of the connecting pipe shall be provided when the valve is open.

Disc on sizes smaller than 10-inches shall be solid bronze and on larger sizes shall be cast iron with bronze facing. Hinge pins shall be of hardened corrosion-resistant alloy.

Valves shall be the product of one of the following manufacturers, or equal:

Clow	Kennedy
M & H	Rensselaer
Traverse City Iron Works	

PLUG VALVES (P)
Plug valves shall be non-lubricated eccentric valves, as called for in the Valve Schedule. End connections shall generally be flanged for all inside valves and mechanical joint for all exterior ground buried valves. Eccentric valves shall be 85% port area type with semi-steel body. Valve bodies shall be suitably marked to indicate whether the valve is open or closed.

The seating surface of the rotating element shall be hycar, neoprene or other material recommended by the manufacturer for sewage service. Bearings at the top and bottom supporting the rotating element shall be permanently lubricated corrosion-resistant type, suitable for sewage plant service. Stem seals shall be O-ring type of the same material as the seating surface and designed so replacement can be accomplished without disassembly of the valve.

All plug valves shall be of adequate design to operate with a pressure of 50 psi on both sides or on either side of the valve without leakage.

Valves shall be the product of one of the following manufacturers, or equal:

DeZurik

SLUICE GATES

Sluice gates shall meet the requirements of AWWA C-501 and be furnished complete including gate, thimble, rubber gasket, mounting hardware, anchor bolts and all appurtenances as listed in the Schedule or shown on the Drawings.

Sluice gates shall be furnished with ASTM A126 Class B cast iron items, seating faces made of strips of ASTM B-21 Alloy A or B extruded bronze, wedges, thrust nut, lift nut, or stem block, and stem couplings shall be ASTM-B147, Alloy 8A, or B132 Alloy B bronze. All assembly bolts shall be bronze per ASTM B-98 Alloy A, B or D. Studs, nuts, anchor bolts and stems shall be ASTM A276 304 or ASTM A582-303 stainless steel.

The side wedges shall be solid cast bronze, machined on all contact surfaces and keyed to the cast iron pads to maintain adjustment by preventing undesirable rotation or lateral motion. Top and bottom wedges shall be solid cast bronze non-rotating and adjustable with a locking device. Wedges will be attached to the disc with silicon bronze studs and nuts and will be designed for field adjustment. Wedges shall be located at all corners and at disc stiffeners as required. Top and bottom wedges are not required on gates below 8 feet unseating head.

Normally Type "F" wall thimble shall be furnished for mounting sluice gates. Type "E" wall thimbles shall be furnished if recommended by the manufacturer for high unseating pressures. Special wall thimbles shall be furnished if noted on the Schedule.

Stem sizing must be designed to accept the maximum thrust of the operator based on 100 foot pounds being applied to the operator. Stem size in conjunction with bronze bushed stem guides shall limit the L/r ratio to 200 maximum.

Stems of more than one section shall be jointed by bronze couplings threaded and keyed to the stems.

Operators shall be as specified hereinafter and shown on the Schedule.

Sluice gates shall be the product of one of the following manufacturers, or equal:

Armco
Rodney Hunt

VALVE JOINTS

BELL
Bell lead joints shall meet the requirements of ASA A21.10.

FLANGE
Flanges shall meet the requirements of ASA-B16.1 Standard Class 125, except that bolt holes at shaft hubs may be drilled and tapped on the flanges. Flanges faces shall be coated with a rust inhibitor immediately after drilling.

GROOVED COUPLING
Grooved coupling joints shall be the rigid type and shall have housing fabricated in two or more parts of malleable iron in accordance with ASTM specification A47 Grade C32510. Ends shall be factory grooved in accordance with the coupling manufacturer's standard groove dimensions. Bolts shall be oval neck track head type with hexagonal heavy nuts, per ASTM A-183 and A-194 Gasket material shall be Grade "H", "E" chlorinated butyle or E.P.D.M. for water service.

MECHANICAL
Mechanical joints shall conform to ASA A-21.10 and A-21.11 and AWWA C110 and C111.

PUSH-On
Push on joints shall conform to ASA A21.11 and AWWA C111.

SCREWED
Screwed joints shall conform to American Standard dimensions ASA B16.3 and threads ASA B2.1.

WAFER
Wafer joints shall be flat face or raised face for use between standard flanges.

OPERATORS

GENERAL

Operators shall be as called for in the valve schedule and as shown on the Drawings. Operators shall be designed with a safety factor of 5 for all torsional and shear stresses. The operating mechanism shall be so located and so designed that all parts subject to the maintenance shall be easily accessible.

All manual operators shall be so sized that a maximum of 80 pounds of rim force/pull is required for operation.

Positions of operators shall be approved by the Engineer.

Valve shall be made to open when turned to the left or counterclockwise.

The direction of the operator to open position shall be indicated on the operator.

OPERATORS

BEVEL GEAR
Bevel gear activators shall provide vertical mounting of the handwheel. Handwheels shall be included.

CRANK/HANDLE
Cranks shall be cast iron with a rotating brass grip. They shall be a maximum of 15-inches in length and keyed to the operator nut.

CHAINWHEEL
Chainwheels shall be cast iron and furnished complete with chain and guides. Chain shall be galvanized and shall be looped to extend to within 4 feet of the floor below the valve.

HANDHWEEL
Handwheels shall be fabricated steel. They shall be a maximum of 30-inches in diameter and keyed to the operating nut.

LEVER
Lever shall be fabricated steel. They shall include a set screw and be grease lubricated.

WRENCH HEAD
Wrench heads shall be cast iron with set screw. They shall be furnished for all wrench nuts except where extension stems or T-handle wrenches are required.

WRENCH NUT
Wrench nuts shall be provided with a 2-inch operating nut when a T-handle wrench or extension stem is required. All other wrench nuts shall be furnished with a wrench head.

CHAIN LEVER
Chain lever shall include chain and lever. Materials shall be galvanized.

INFINITE LEVER
Infinite lever shall be of extra heavy steel and capable to be moved to any position and locked in place by a simple wing nut.

POSITION LEVER
Position lever shall be of extra heavy steel with a multiple position throttling plate.

BENCH STAND
Bench stands shall meet the requirements of floor stands as hereinafter specified except base plates replace pedestals.

CONTROL PACKAGE
The control package shall consist of indicating lights, open-close-stop pushbutton stations, local-remote control selector, strip headers, and all associated wiring factory assembled, all mounted in a NEMA 4 enclosure unless otherwise noted in the Schedule.

EXTENSION BONNET
Extension bonnets shall be cast iron and be furnished complete with galvanized assembly bolts.

EXTENSION STEM/SHAFT
All extension stems shall be 304 or 303 stainless steel with bronze couplings. Stems of more than one section shall be jointed by bronze couplings threaded and keyed to the stems. Extension stem shall have a 2 wrench nut end connection for T-handle wrench operation.

Extension shafts shall be 304 or 303 stainless steel with universal joint couplings.

FLOOR BOX (Length)
Where openings through concrete slabs are provided for key operation of valves and extension stems connected therewith, the operating nut being in or below the slab, such openings shall be provided with a floor box, complete w/cover, which shall be Ludlow Fig. 340, Clow F-5695, or equal. Each floor box shall be of the depth required for installation as shown in the Schedule and shall have cast on the cover an appropriate name designating the service for which the valve is used. In addition, where the operating nut is in the slab, the floor box shall be bronze bushed; where below, the opening in the bottom of the box shall be sufficient for passage of the operating key.

Each floor box and cover therefor shall be coated by dipping in hot asphaltum varnish.

FLOOR STAND
Floor stands shall meet the requirements of AWWA C501 for Manual Operating Mechanism except as hereinafter specified.

Floor stands shall have a high-strength cast iron pedestal type furnished with lubrication fittings and stainless steel, double nutted anchor bolts.

All geared floor stands shall have weatherproof housings.

All floor stands shall be provided with a galvanized steel stem cover, position indicator and the direction of rotation to open the gate shall be indicated.

The operating stem will be 304 or 303 stainless steel. On aluminum gates the stem will be connected to the disc by means of an aluminum angle connection, threaded and bolted for the stem and welded to the disc.

A sleeve made from standard weight galvanized steel pipe shall be provided for the opening in the floor beneath each operating stand.

Connections of stems to stainless steel or fiberglass gates shall be as per the manufacturers recommendations.

POSITION INDICATOR
Position indicators shall be of bronze or cast iron construction.

LIMIT SWITCH
Limit switches shall be Allen Bradley BUL-802X spring centered or Square 'D', Class 9007, or equal, with type operator as required in NEMA-4 enclosure with 1-NO and 1-NC contacts and rated at 10 amps at 600 V ac.

Two limit switches shall be factory mounted to the valve or gate assembly for indicating full open and full closed positions.

MANUAL SCREW
Manual screw operators shall meet the requirements of AWWA C504 operators.

REMOTE POSITION INDICATOR
Remote position indicators shall be the isolated 100 ohm potentiometer design for use with a remote position indicator. Resolution of 1/2 percent shall be required and potentiometer shall be directly attached to or geared from the valve or gate operating shaft.

STEM COVER
Stem covers shall be galvanized steel with position indicators and cap.

STEM GUIDE
Stem guides shall be cast iron construction with bronze bushings adjustable in two directions and furnished with mounting assembly and anchor bolts of stainless steel.

T–HANDLE WRENCH
T-handle wrench shall be Clow F-2520 valve wrench, Traverse City Iron Works A-160 valve key, or equal.

VALVE BOX
Valve boxes shall be of cast iron, adjustable and furnished complete including cover, top section, center sections and base. Valve boxes shall be not less than 5-inches in diameter and shall have a minimum thickness at any point of 3/16-inch.

Covers shall have cast thereon an appropriate name designating the service for which the valve is used.

All parts of valve boxes, bases, and covers shall be coated by dipping in hot bituminous varnish.

WALL BRACKET
Wall brackets shall be cast iron and furnished with stainless steel assembly and anchor bolts.

WORM GEAR
Worm gear operators shall meet the requirements of AWWA C504 operators.

PILOT ASSEMBLY
Valve mounted pneumatic pilot position control assembly shall include three suttle/spool valves, three solenoids, complete with manual overrides, and speed control valves all mounted on a single manifold base. Each suttle/spool valve shall include "O" ring seals for tight shutoff. Speed control valves shall be integrally connected to the manifold base. Pilot assembly will provide a means to open an actuator in an adjustable range of 0 - 5 minutes, shut an actuator in an adjustable range of 0 - 5 minutes and emergency actuator closing in an adjustable range of 0 - 10 seconds.

VALVE AND GATE SCHEDULE KEY

GENERAL

The following valve schedule and gate schedule gives the designation for each valve or gate, its location, service size, quantity and other pertinent data.

The distance given with extension stems or shafts is that from center line of port to top of floor at floor stand or floor box, or from center line of port to ground surface for valve box.

The distance given for butterfly valves with extension bonnets is that from centerline of valve to the centerline of the operator, 3 feet above operating floor or slab.

The distance given with chain wheels is from the center line of valve to bottom of loop.

The distance given for valve box is from the center line of valve to ground surface.

No valves or gates smaller than 4-inches are included in the Schedules.

Unless otherwise noted in the Schedule, the valve class shall be 150, except butterfly valves for air service shall be class 25, stems shall be of the non-rising type for valves and rising type for gates, service use shall be open shut, motors shall be 220/440 volt, 60 cycle, 3Hz A.C. and enclosures shall be NEMA 4.

Included in the remarks column will be exception to class, stem, service, motor and motor enclosure requirements, etc.

The key of symbols for the schedules is as follows:

SCHEDULE KEY

VALVE JOINT

B	-	Bell
F	-	Flange
GC	-	Grooved Coupling
M	-	Mechanical
PO	-	Push-on
S	-	Screwed
W	-	Wafer

SLIDE GATE TYPE

A	-	Aluminum
FG	-	Fiberglass
SS	-	Stainless Steel

(continued)

OPERATOR

BG	-	Bevel Gear
C	-	Crank/Handles
CL	-	Chain Lever
CW	-	Chain Wheel (length)
H	-	Hand Wheel
HO	-	Hydraulic Oil
HW	-	Hydraulic Water
IL	-	Infinite Lever
L	-	Lever
M	-	Motor
P	-	Positioner
PL	-	Position Level
POC	-	Pneumatic Cylinder
POD	-	Pneumatic Diaphragm
W	-	Wrench Head
WN	-	Wrench Nut

SLUICE GATE TYPE

C	-	Conventional
SB	-	Standard Bottom
FB	-	Flush Bottom
SC	-	Self Contained
FF	-	Flat Frame
FLF	-	Flange Frame

ACCESSORIES

BS	-	Bench Stands
CP	-	Control Package
EB	-	Extension Bonnet (length)
ES	-	Extension Stem Shaft (length)
FB	-	Floor Box w/stand
FS	-	Floor Stand
PA	-	Pilot Assembly
PI	-	Position Indicator
LS	-	Limit Switch

ACCESSORIES (Continued)

MS	-	Manual Screw
RPI	-	Remote Position Indicator
SC	-	Stem Cover
SG	-	Stem Guide
THW	-	"T" handle wrench
VB	-	Valve Box w/cover (length)
WB	-	Wall Bracket
WG	-	Worm Gear

REMARKS

CL	-	Class
GB	-	Ground Buried
NRS	-	Nonrising Stem
OS	-	Open Shut
RS	-	Rising Stem
Th	-	Throttling

VALVE SCHEDULE

Mark	Location	Service	Size Inches	Quantity	Joint	Operator	Accessories	Remarks
BUTTERFLY VALVES								
B-1-1 B-1-2	Valve Chamber	Wash water Drain	36	2	F	WN	FB, 12-in., THW 15-ft.0-in. long	Cl. 25
CHECK VALVES								
C-1-1 and C-1-2	Pump Room	Wash water Drain	12	2	F			
PLUG VALVES								
P-1-1 and P-1-2	Pump Room	Wash Water Return	12	2	F	WN		Provide (1) removable lever operator for wrench nut
P-2-1 and P-2-2	Pump Room	Wash Water Return	12	2	F	WN		
P-3-1	Control Bldg.	Wash Water Return	12	1	F	CW (5-ft.6-in.)		
P-4-1	Control Bldg.	Wash Water Return	12	1	F	CW (9-ft.9-in.)		
P-5-1	North Gallery	Wash Water Return	12	1	F	CW (13-ft.8-in.)		

10. SPECIAL PUMPS

GENERAL

SCOPE OF WORK

This work shall be subject to the conditions of the General Requirements and include the furnishing of labor, materials, tools, equipment, accessories and services necessary for providing and installing the items as shown on the Contract Drawings and/or as herein required.

Equipment furnished and installed under this section shall be fabricated, assembled, erected, and placed in full conformity with detail Drawings, specifications, engineering data, instructions and recommendations of the equipment manufacturer as approved by the Engineer. Special attention shall be given to the General Equipment Stipulations of the General Requirements.

Work Included. The principal items of work and design conditions are stated in the Schedule.

Related Work By Others.

Section	3	- Concrete
Section	6	- Finishes
Section	8	- Pipe Work
Section	12	- Plumbing and HVAC
Section	13	- Electrical

EQUIPMENT DATA SHEET

Prior to the taking of bids for this contract, the manufacturer of the equipment furnished under this section shall furnish the Engineer the information listed in the Equipment Data Sheets. The purpose of the data sheets is to furnish the Owner necessary information so that an evaluation of the equipment can be accomplished.

SHOP DRAWINGS AND GUARANTEES

Furnish, as prescribed under the General Requirements, Shop Drawings and Guarantees covering the items included under this section of the Contract.

PUMPS

The pumps shall be horizontal end suction having the respective capacities and duty points as listed in the Schedule.

The discharge head will consist of the static lift plus the friction head in the suction and discharge piping. Special suction conditions, if required, are as shown on the Schedule.

The total heads stated in the Schedule shall be developed by the pumping units between any points of test specified in the shop test procedure. Any losses incurred between these points of test are not included.

Pumps using the maximum size impeller will not be accepted.

Speed for pumps shall not exceed 1200 rpm. The pumps shall be arranged as nearly as the types will permit to those indicated on the Drawings with direction of rotation as required by the installation shown.

Casing. Pump casings shall be made of 28% chrome iron, free from imperfections, and of suitable thickness to withstand the specified pressures. Joints shall be provided with rigid heavy flanges, and machined so as to make water-tight joint using thin paper gaskets. Casings shall be tested with internal hydrostatic pressures of at least 50 psi and under this test pressure shall show no leakage or distortion. The casings shall be provided with suitable openings for priming connections, air vents, drainage, gauges and with suitable eye bolts for lifting. Pumps shall have flanged suction and discharge connections which shall be faced and drilled according to American Standard templates. Piping and bolts for connecting same to the pumps will be provided and installed under "Pipe Work."

Impellers shall be of the single suction type. Impellers shall be constructed of 28% chrome iron, carefully machined balanced statically and dynamically, finished smooth inside and outside and firmly secured to the shaft with a bronze nut.

Shaft. The pump shaft shall be high grade carbon steel, SAE 1045 minimum, machined true, straight and round. They shall be fitted with removable sleeves of corrosion-resisting material where they pass through the stuffing boxes. All other parts of the shaft shall be finished and polished.

Wearing and sealing rings shall be designed for grease seal. Wearing rings, shaft sleeve and packing gland shall be of a corrosion-resisting material.

Stuffing Box. The stuffing box head shall be a 28% chrome iron, bolted to the volute. It shall contain a stuffing box designed to accommodate, interchangeabl, either a double, positive-drive mechanical seal or graphite asbestos packing with grease sealing lantern ring. This stuffing box shall be tapped in a convenient location of a sealing water connection.

Seals. As assembled at the factory, the pumps shall be equipped with graphite asbestos packing.

Base. A fabricated steel baseplate for the pump and motor shall be furnished. Bases shall be provided with drain connections. The baseplate shall be constructed to support the full weight of the pump and motor and shall be provided with suitable anchor bolt holes.

The pumps shall be belt driven and the motors mounted above the pump on suitable motor mounts. The pumps and motors shall be furnished with multiple sheaves to adjust pump speed plus or minus ten percent of the speed required to meet the duty point.

Bearings. Bearings shall be anti-friction ball, roller or pillow block type. Lubricaton shall be grease and openings provided for lubrication and cleaning.

Wearing Rings. On all pumps above 6-inch removable wearing rings of unlike stainless steel shall be furnished on the impellers and suction heads. Wearing rings shall utilize radial wearing surface. Wearing rings on the back of the impeller or ports to balance the hydraulic thrust of the pump will not be acceptable.

Electric Motors. They shall be of the vertical or horizontal shaft as required. Each motor shall be provided with a suitable thrust bearing which will carry the load of the rotor together with that of such parts of the shaft as may not be carried by the pump.

Pump motor nameplate horsepower shall be sufficient for non-overloading operation at all points on the General Equipment Stipulations and with details outlined in the attached Schedule.

TESTING

Each pump shall be fully tested on water at the manufacturer's plant before shipment. If the pump manufacturer supplies the driving motor, pump and motor shall be assembled and tested as a unit. Tests shall consist of checking the unit at its rated speed, head, capacity, efficiency and brake horsepower and at such other conditions of head and capacity to properly establish the performance curve. Certified copies of test reports shall be submitted to the Engineer prior to shipment of the pump to the job site. The standards of the Hydraulic Institute shall givern the procedures and calculations for these tests.

In case the pumps are tested separately from the motors, the Contractor shall furnish certified characteristic curves of the motors to be furnished as guaranted by the motor manufacturer. These characteristic curves shall be obtained either from actual tests from the motors to be furnished or from tests of motors of the same size and type of construction.

PERFORMANCE TESTS

After the pumping units have been erected, the Owner will run a performance test. The purpose of this performance test shall be to demonstrate that the units have been properly erected, and that they and their appurtenant equipment will operate satisfactorily and meet the guarantees of the Contractor. For the purpose of this test, the Owner will furnish the electricity, lubricating oil, and for a test load, if and when these items are available. The measurement of the quantity of water pumped may or may not be included in the performance test. The performance test shall be conducted under the supervision of the Engineer with the cooperation of the Contractor's factory representative. It is intended that this test shall be carried out by operating each pumping unit through the range specified for a continuous period of at least two hours, or until it is shown to the satisfaction of the Engineer that all the equipment is in perfect condition and will meet the guarantee. Throughout these tests of the pumping equipment, the motors and pumps must run smoothly without bibration or heating, otherwise the test shall be stopped and not again undertaken until the unit shall have been put into condition to comply with the requirements for smoothness of operation.

SUGGESTED MANUFACTURERS

Equipment shall be the product of one of the following manufacturers, or equal:

Hazleton - CBE
Morris
Nagel-KR

SPECIAL PUMP SCHEDULE

No. of Units	Type	Service	Location	Capacity	Discharge Pressure or Head	Motor Description	Remarks
2	Abrasive Service Pumps	Waste Filter Wash water	Pump Room of Wash Water Retention basin	1400 gpm	50 feet	ODP, 460-3-60 V-belt drive Multiple sheave	Resin Encapsulated windings Motor mounted pump. Multiple sheave

SPECIAL PUMP

ABRASIVE SERVICE PUMP

Equipment Data Sheet

The manufacturer of this equipment shall submit to the Engineer, 72 hours prior to the receipt of bids, the following specific data on the equipment being offered. The purpose of this information is to provide the Owner the information necessary to evaluate the equipment. Failure by a manufacturer to furnish all the information requested may be cause for rejection of the equipment.

1. Pumps

   a. Manufacturer: _____

   b. Model Number: _____

   c. Size: suction diameter: _____ inches, discharge diameter: _____ inches.

      maximum impeller diameter: _____ inches

   d. Impeller diameter for specified duty point: _____ inches

   e. Speed: _____ rpm

   f. Shut-off Head: _____ ft.

   g. Efficiency at duty: _____ %

   h. NPSH required at duty point: _____ ft.

2. Motors

   a. Manufacturer: _____

   b. Horsepower: _____

3. Total weight of pump, motor and base: _____ lb.

(Note: Attach performance curves)

BY: _____

Phone No.: _____

Date: _____

11. MECHANICAL INSULATION

GENERAL

SCOPE OF WORK
This work shall be subject to the conditions of the General Requirements and include the furnishing of labor, materials, tools, equipment, accessories, and services necessary for providing and installing the items as shown on the Contract Drawings and/or as herein required.

Material furnished and installed under this section shall be fabricated, assembled and erected in full conformity with detail drawings, specifications, engineering data, instructions, and recommendations of the manufacturer as approved by the Engineer.

This work shall include all mechanical insulation of items as shown on the drawings and/or specified herein. All sizing required shall be performed under this section.

Related Work By Others.

Section	6 - Finishes
Section	8 - Pipe Work
Section	12 - Plumbing, and HVAC

SHOP DRAWINGS AND GUARANTEES
Furnish, as prescribed under the General Requirements, Shop Drawings and Guarantees covering the items included under this section.

Contractor shall furnish the Engineer for approval a list of insulating materials and thickness for items listed in the Schedule.

SUGGESTED MANUFACTURERS
Insulation shall be the product of one of the suggested manufacturers listed, or equal.

INSULATION

GENERAL
Insulation shall be neatly installed by skilled workmen following insulation manufacturer's recommendations. Piping, ducts, tanks and equipment shall be clean and dry and all piping shall have been tested before insulation is installed.

Ajoining sections shall be butted firmly together with longitudinal seams and end joints sealed with a manufacturer recommended adhesive. Staples are not to be used. Jacket laps shall be neatly pasted in place. All adhesives used shall contain an anti-bacterial agent.

Exposed covering shall be cleaned and sized for painting using Arabol, Fosters, Lagfas, or equal as approved by the Engineer. Painting will be performed under Finishes.

Premolded sectional covers shall be applied to flanges, fittings and valves where possible. All other flanges, fittings and valves shall be field insulated and jacket applied manually. Insulation shall be the same thickness as that of the pipe.

In general, pipe hangers will be sized to fit the pipe with insulation placed over the pipe hanger assembly. Insulation shall be grooved for hangers. The hanger area shall be completely filled with insulating material and sealed in vapor barrier areas.

Insulation where terminated at equipment connections, ends of pipe, etc. shall be tapered at a 45 degree angle and sealed.

TYPES OF INSULATION
Insulation for the interior service water piping shall be the following type.

Type I. Type I insulation shall be a precision molded pipe covering composed of bonded fiberglass wool resin minimum density 7.25 pcf or polyurethane or phenolic foam min. density 1.8 pcf formed in two half cylinders.

Indoor insulation cover shall be the all service jacket ASJ type with integral vapor barrier.

All ASJ jacket laps and butt joint strips shall be of the adhesive contact type.

Fitting and valve insulation shall be fabricated from mitered segments of pipe insulation or molded fitting covers. Fitting and valve insulation shall be coated with insulating cement, dried, coated with vapor barrier mastic and wrapped with fiverglas reinforcing cloth and a second coat of mastic applied.

Suggested Manufacturers, or equal:

Armstrong - Armolok/Accotherm
CSG
Johns-Manville - Flame-Safe AP-T
Owens/Corning Fiberglas
UpJohn Company
Philip-Carey Mfg. Co.

INSULATING CEMENT
Insulating cement shall be mineral fiber ASTM C449 and designed for use on hot or cold surfaces from temperature ranges of 0 - 1200°F.

Suggested Manufacturers, or equal:

Keene Corp., Super Powerhouse
Grant Wilson - Insul-All
Owens/Corning Fiberglass - OC-600

Insulating cement for temperatures above 1200°F shall be a dry mix composed of spun mineral wood granules, benitonite clay and asbestos fiber ASTM C195.

MECHANICAL INSULATION THICKNESS
Type 1 insulation thickness shall be 1-inch based on fiberglass with a K factor (thermal conductivity Btu/hr sq.ft. F/in) of 0.255 at 40°F. Insulation thickness may be increased or decreased in direct proportion to the K factor of the insulation material furnished.

12. PLUMBING, HEATING, VENTILATING AND AIR CONDITIONING

GENERAL

SCOPE OF WORK
This work shall be subject to the conditions of the General Requirements and include the furnishing of labor, materials, tools, equipment, accessories and services necessary for providing and installing the items as specified herein in the locations shown on the Contract Drawings.

Equipment furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with detail drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer as approved by the Engineer. Special attention shall be given to the General Equipment Stipulations of the General Requirements.

Work Included. In general, unless noted on the Drawings or specified herein, all piping less than 4-inch in diameter, and all sizes for drainage system piping shall be part of this work.

This work shall also include the furnishing and installation of all heating, ventilating and air conditioning systems as specified herein and located as shown on the Drawings.

Furnish, set and grout or secure in proper alignment all required sleeves.

Furnish and install all pipe encasement concrete meeting the requirements as specified under Concrete.

Touch-up and finish painting of factory finished equipment furnished under this work shall be included.

All necessary joint and coupling materials, including bolts, nuts and gaskets, wall castings or sleeves and standard or special fittings shall be provided as part of this work. Hangers, supports, anchors, blocking, harnesses, and other necessary closure pipe sections and special fittings shall be furnished and installed.

All testing herein specified shall be accomplished under this section of the work.

Related Work By Others. The following is a list of related work that will be done under other Sections of the work:

Section	3 - Concrete
Section	6 - Finishes (painting)
Section	8 - Pipe Work (piping 4-inch & larger)
Section	11 - Mechanical Insulation
Section	13 - Electrical
Misc.	Equipment Sections

All exposed pipe field applied finish painting, including preparation and repair of existing painted surfaces, shall be accomplished under Finishes.

DRAWINGS
The Drawings are not intended to show every detail of construction. Where building construction makes it necessary or advisable to change location of piping, ducts, or equipment, the Contractor shall so inform the Engineer for his approval.

The Contractor shall give to all trades the exact locations and sizes of all openings required for piping, air ducts, and equipment plus information as to all spaces required.

PERMITS, INSPECTIONS AND LICENSES
The Contractor shall procure all necessary permits and licenses, observe and abide by all applicable laws, regulations, ordinances, and rules of the state, territory or political subdivision thereof, wherein the work is done, or any other duly constituted public authority, and further agrees to hold the Owner harmless from liability or penalty which might be imposed by reason of an asserted violation of such laws, regulations, ordinances or other rules.

Upon completion of the work, the Contractor shall secure certificates of inspection from the inspector having jurisdiction and shall submit three copies of the certificates to the Owner.

The Contractor shall pay the fees for the permits, inspections, licenses and certifications when such fees are required.

SUBSTITUTIONS
References made in these specifications to specific manufacturers' products are intended to serve as a guide to type, construction and materials. Substitutions may be made if the Engineer gives prior approval of Shop drawings, cuts or descriptions of items to be substituted.

SHOP DRAWINGS
Furnish, as prescribed under the General Requirements, Shop Drawings covering the items included under this section of the work.

The Contractor shall also submit complete layout drawings of all piping, duct work, etc., showing all sizes and controlling elevations. These drawings shall be reproduceable and submitted on tracing, mylar or sepia paper. No work shall be undertaken until such drawings, specifications and schedules have been approved by the Engineer. Approval of this data by the Engineer shall not

relieve the Contractor of his responsibility for the completeness and dependable operation of the plumbing system as installed.

TESTS, STANDARDS AND CODES

Piping shall be installed in accordance with the latest edition of the ANSI "Code for Pressure Piping."

Pneumatic signal lines shall be tested at 50 psig with air for a period of 24 hours. The pressure drop over that period of time shall not exceed 5 psi.

All other piping shall be tested with water at 1½ times the working pressure or 100 psig, whichever is greater, and shall hold this pressure for a period of four hours with no more than a 10% loss in pressure over the entire time.

Pipe hangers and supports shall conform to Standard Practice SP-58 of the Manufacturers Standardization Society of the Valve and Fitting Industry.

Heating systems shall comply with all local and state codes and shall be installed by a licensed installer.

All instrumented automatic temperature control systems shall be tested in the presence of the Engineer to demonstrate correct operation.

ELECTRIC MOTORS

Electric motors shall meet the requirements of the General Equipment Stipulations of the General Requirements.

All motors shall be totally enclosed unless otherwise noted on the Drawings or listed in the Schedules. Motors on all equipment located in designated areas and in grit removal areas shall be of explosion proof construction.

PIPE HANGERS AND SUPPORTS

Hangers and supports shall include all hanging and supporting devices shown, specified, or required, for piping and appurtenances installed under this section of the work. Hangers and supports shall be of metallic construction.

Hangers and supports shall be adequate to maintain the pipelines, apparatus and equipment in proper position and alignment under all operating conditions, with due allowance for expansion and contraction, including springs where necessary. Hangers shall be of the adjustable height type and shall be sized to support the pipe and insulation. Hangers and supports shall be as manufactured by F&S Central, Grinnell, Unistrut, or equal.

Generally, hangers and supports shall be sized to fit the pipe excluding insulation.

Supporting devices shall be designated in accordance with the best practice and shall not be unnecessarily heavy. Hangers shall be spaced to secure pipe in place without sag or undue stress on any pipe, fitting or valve. Sufficient hangers and supports shall be installed to provide a working safety factor of not less than 5 for each hanger.

Inserts for concrete shall be galvanized steel, stainless steel, or galvanized malleable iron and shall be installed in the concrete structures where required for fastening supporting devices. They shall be designed to permit the rods to be adjusted horizontally in one plane and to lock the rod nut or head automatically. Inserts shall be recessed near the upper flange to receive reinforcing rods. Inserts shall be so designed that they may be held in position during concrete pouring operations. Inserts shall be designed to carry safely the maximum load that can be imposed by the rod which they engage.

The Contractor shall coordinate his work with the Finish Contractor to insure that all pipe under hangers and supporting devices has been painted.

PIPE SLEEVES

Unless otherwise shown on the Drawings, at all points where pipes must pass through walls, floors or roofs of structures, the Contractor shall furnish and install suitable sleeves or wall castings meeting the requirements of the General Equipment Stipulations of the General Requirements.

In general, the wall sleeve or casting shall be of the same material as the pipe, or standard weight galvanized steel pipe thimbles of at least one size larger than the pipe itself shall be installed. Iron pipe wall castings, wall pipe, transition sleeves and solid sleeves shall meet the requirements of AWWA Specification C100 and shall be of the lightest class conforming to the pressure rating of the pipelines which they connect, but in no case shall be lighter than Class B.

FLOOR, WALL AND CEILING PLATES

Where piping, ducts or drain lines pass through floors, walls or ceilings in finished areas, chrome plated cover plates or escutcheons shall be provided. Escutcheons shall be provided for all lines less than 2-inch in diameter. Cover plates shall be provided when openings through existing walls are made by methods other than core drilling.

WORKMANSHIP

Piping, in general, shall be exposed. It shall be run in neat, straight parallel lines, located far enough from finished walls and ceilings to permit access for painting. Care shall be taken in laying out piping that there is not interference with the proper location of piping provided under other Sections of the work. As soon as pipes are in place, all open ends shall be capped or plugged until permanent connections are made.

No change shall be made in general location shown for piping or in the method of running and connecting same, except with the written approval of the Engineer. When

any change is made, a record of the location of all pipe so changed shall be kept by the Contractor. A copy of such record shall be given to the Engineer.

INSULATION
All piping systems and equipment hereinafter specified shall be insulated as specified in Section 43 - Mechanical Insulation.

EQUIPMENT CONNECTIONS
The connecting piping to equipment shall be supported independently of the equipment so as to avoid any strain on the equipment. All equipment connections shall be flanged or have unions to facilitate removal of the equipment. Piping to air compressors and other vibrating equipment shall contain a flexible connection of Buna N as manufactured by Metra Flex, Mercer Rubber Company, RKL Controls, or equal, or of stainless steel as manufactured by Atlantic Metal Hose Company (Vibraflexor), Allied Metal Hose Company, POM Sola-Flex Division, Universal Oil Products Flexonics Division, or equal.

CATHODIC PROTECTION
Insulated and gasketed, galvanized, malleable iron unions, as manufactured by Crane No. 1259, ITT Grinnell Figure 470, or equal, or flanged connections shall be furnished and installed on all connections between dissimilar piping material and on piping connections to equipment to prevent galvanic corrosion.

PAINTING AND IDENTIFICATION
Painting of piping and drainage lines installed as a part of this work will be done under "Finishes." The Contractor under this section shall identify and label various lines clearly so the painting contractor will be able to apply the correct color(s) to each pipe.

CONFORMING TO CONSTRUCTION RECORDS DRAWINGS
The Contractor shall submit a complete set of drawings showing the locations of the piping, duct work, etc., as actually installed. Such drawings shall be submitted to the Engineer on tracing cloth, mylar or sepia paper from which blueprints can be obtained.

GUARANTEE
The Contractor shall furnish a manufacturer's guarantee as set forth in the General Requirements covering the items included under this section of the work.

PIPE MATERIALS

Copper Pipe

	Size	Description
Pipe	¼" - 1½"	ASTM B88 Type L drawn temper (hard) copper tubing (indoors) ASTM B88 Type K drawn temper (soft) copper tubing (underground)
Fittings	¼" - 1½"	Wrought copper, Flared Joint (underground)
Valves	3/8" - 1½"	
Shutoff		125 lb. bronze gate, RS one-piece wedge disc
Throttling		125 lb. bronze globe composition disc,
Check		125 lb. swing check, bronze disc disc stop, screwed cap, straight thru flow
Stop & Waste		125 lb. bronze globe, right-hand drain, composition disc
Hose bibs	¾"	Bronze, garden hose thread
		Bronze, iron pipe hose thread
Sill Cocks	¾"	Non-freeze wall hydrant, brass casing, vandal-proof w/handle
Flushing Hose Bibbs	1½"	125 lb. bronze gate with fire horse thread

All joints shall be soldered.

Suggested Manufacturers: Crane, Lunkenheimer, Walworth, Jenkins, or equal.

Galvanized Steel Pipe.

	Size	Description
Pipe	2" - 3"	ASTM A-53 or A-120 std. weight
Fittings	2" - 3"	125 lb. malleable iron galv. ASTM A-47
Valves	2" - 3"	
Shutoff		125 lb. bronze gate, RS, wedge disc, w/wheel or 400 lb. WOG forged bronze ball valve
Throttling		125 lb. bronze globe, w/wheel
Check		125 lb. bronze swing check, bronze disc, unobstructed passage, screwed cap.

All joints shall be screwed.

Suggested Manufacturers: Crane, Jamesbury, Jenkins, Lunkenheimer, Walworth, or equal.

Black Steel Pipe,

	Size	Description
Pipe	½" - 3"	ASTM A53, seamless Grade G Schedule 80
	1" - 3"	ASTM A-53, seamless, Grade B Schedule 40
Fittings	¾" - 2"	125 lb. cast iron screwed
	2½" - 3"	ASTM A234, Grade B, welded steel
Unions	½" - 2"	150 lb. steel
	2½" - 3"	125 lb. cast iron screwed compression flanges
Valves		
Gate	¾" - 2"	All brass, solid wedge, inside screw, RS
	2½" - 3"	All brass, solid wedge, flanged, RS
Globe	½" - 3"	130 lb., all iron, or brass, stainless steel disc & seat
Angle	½" - 3"	150 lb., all iron or brass, stainless steel disc & seat
Check	½" - 2"	250 lb. all iron or brass swing check
	2½" - 3"	125 lb., all iron or brass swing check unobstructed passage, bolted cap
Ball	½" - 2"	2000 lb., carbon steel, with handle
Plug	½" - 3"	150 lb., carbon steel, with handle non-lubricated eccentric, with wrench

All valves ½-inch - 2-inch shall have screwed joints. All valves 2½-inch - 3 -inch shall have flanged joints.

Suggested Manufacturers: Crane, Lunkenheimer, Walworth, Jenkins, Jamesbury, Homestead, or equal.

WORK INCLUDED

This item includes the furnishing and installation of the duplex sump pumps, all piping and valves for the sump pump discharge piping and service water system.

This work shall include connection to equipment which is installed under other sections but which is a part of any of the previously mentioned systems. This work shall include the installation of equipment and accessories furnished under other sections, but which is a part of any of the previously mentioned system.

Equipment requiring incorporation into this work shall be unloaded and stored under this section.

DRAINAGE SYSTEM

All sump pump discharge piping as shown on the Drawings shall be provided under this heading. All drainage piping shall be temporarily sealed after testing to prevent entry of debris.

PIPE MATERIAL AND APPLICATION

Sump pump discharge piping shall conform to local codes and consist of the following materials:

Galvanized Steel (ASTM A-53). Pipe shall be Schedule 40 with 150 lb. galvanized malleable iron screwed fittings.

Copper Pipe and Fittings (ASTM B-88). In lieu of galvanized steel.

DUPLEX SUMP PUMPS

This work shall include the furnishing and erection of one set of duplex sump pumps.

Pump Design and Performance. Pump design shall provide maximum operating efficiency at or greater than the specified flow. In the case of duplex sump pump, the capacity listed in the Schedule shall be for each pump. Pump casings shall accommodate at least one size larger impeller than required to meet the duty points. The pumps shall be heavy duty, non-clog bilge sump pumps for wet well installation. Pumps shall be grease lubricated. Discharge piping shall terminate above the cover plate with a screwed connection. Unless otherwise shown on the Drawings the pump shall be so arranged that the suction is approximately six inches above the bottom of the sump.

The pump casings shall be constructed of strong, close-grained cast iron, free from imperfections and of suitable thickness to withstand the specified pressure.

The volute type casing shall be suspended from a ½-inch minimum thickness steel suspension plate. The impeller drive shaft shall be of carbon steel, ground and polished through its entire length and enclosed in Schedule 40 Yoloy steel pipe. Axial shaft and impeller thrust and weight shall be carried by an adjustable ball thrust bearing, grease lubricated, and mounted 9 inches above the suspension plate in a combination bearing housing and motor support.

A renewable sleeve-type bearing shall be furnished in the ejector casing. The pump shaft shall be connected to the motor shaft by a flexible coupling of the load cushion type. Discharge pipe shall be Schedule 40 Yoloy steel pipe.

The impeller shall be a fully enclosed non-clog design with blunt entering edges, smooth contours and other design features to prevent rags and stringy material from binding between the impeller and the casing. The impeller shall be close-grained cast iron, carefully machined, and firmly secured to the shaft. The impeller shall be balanced and furnished with repelling vanes on the side opposite the suction to reduce sleeve bearing wear and provide proper flow of lubricant.

Each pump shall have a capacity of 30 gpm at a discharge head of 22 feet. The pumps shall be suitable for installation in a sump 36-inch diamter by 4 feet deep.

Motor. Maximum motor speed shall be 1750 rpm. Pump motor nameplate horsepower shall be sufficient for non-overloading operation at all points on the performance curve for the impeller selected to meet the duty point. These conditions shall be met without exceeding electric motor design criteria set forth in the General Equipment Stipulations of the General Requirements for 460, 3 phase, 60 Hz motors.

Base and Cover Plates. The pumps, motors and discharge pipe shall be mounted on a common base plate which in turn shall be bolted to a suitable cover plate. The cover plate shall have a manhole 11 by 15-inches, minimum, and shall have a 4-inch threaded coupling welded to the plate as a vent connection. All anchor bolts, gaskets and base plate bolts shall be provided.

Controls. Float switches shall be mounted on a pedestal and bolted to the main cover. For duplex pumps, two two-pole 110 V a-c heavy float switch assemblies with double break contacts, brass or stainless float rod, steel straps, float rod guide pipes and copper floats shall be provided. All float switch contacts shall be NEMA 4 enclosure and close on rising level. For duplex pumps an alternator in NEMA 4 enclosure, Square D, Allen Bradley, or equal, with high level alarm contacts shall be provided.

Suggested Manufacturers. Equipment shall be the product of one of the following manufacturers, or equal:

Yeomans Brothers Co. Series 3000
Aurora Pump
Fairbanks Morse Co.

SERVICE WATER SYSTEM

Service water system piping materials shall be copper or galvanized steel pipe as specified under Pipe Materials. Service water piping shall be connected to all items indicated on the Drawings or required for a complete job.

SEALING WATER CONNECTIONS

Sealing water shall be brought to connections on centrifugal pumps. Each connection shall be provided with a throttling valve, wye-strainer, rotameter, solenoid operated valve, and shut-off valve as shown on the Drawings. The throttling and shut-off valves shall be as specified under Pipe and Fitting Materials.

Wye-Strainer. Strainer shall have 150 psi maximum pressure rating, cover shall be screwed or bolted, body shall be cast iron or PVC, straining element shall be stainless steel or PVC, openings shall be 1/32-inch in size. The open area of the strainer basket must be at least twice that of the corresponding pipe size. Strainer shall be as manufactured by Zurn, Hayward Manufacturing Co., or equal.

Solenoid Valves. Solenoid valves shall be the direct operated type, standard construction with NEMA 4 or NEMA 7 housing as required; bronze body with stainless steel internal parts; for hydraulic service; high temperature, molded, waterproof, Class H (180°C) coils; gasketed housing and; manual non-locking override. Solenoid shall be Skinner Electric Valve, Double A Hydraulic Equipment, Versa Pneumatic/Hydraulic Valves, or equal.

PRESSURE REDUCING STATION

A sealing water pressure reducing station shall be provided. Each reducing station shall be provided with a shut-off valve, check valve, wye strainer, pressure regulator, and pressure gauge. The shut-off and check valves shall be as specified under Pipe and Fitting Materials.

Wye Strainer. The strainer shall be as specified under Sealing Water Connections.

Pressure Regulator. Regulator shall have maximum initial pressure limit of 100 psi, and a reduced pressure range of 5 to 35 psi. Regulator shall be a direct acting, spring loaded, diaphragm type for hydraulic operation, and shall be capable of maintaining a constant delivery pressure. An adjusting screw shall be easily accessible for changing the outlet pressure.

Valve body shall be bronze or cast brass, seat shall be stainless steel, diaphragm shall be Buna N. Regulator shall be as manufactured by Watts, Masonelian, or equal.

Pressure Gauge. Pressure gauges shall have a drawn steel case and ring, 4½-inch steel dial with white background and black markings, clear glass window, aluminum pointer with black finish, brass movement, and milled teeth, bourdon tube of drawn grade A phosphor bronze with silver-brazed joints, and a ¼-inch NPT brass bottom outlet. Accuracy shall be 2% of full scale. Scale range shall be 0 to 100 psi.

ROTAMETERS

Rotameters shall be for service water service, sized with capacities as noted on the Drawings. Rotameters shall be 10-inch tube length for vertical mounting equal to Fischer and Porter, Wallace and Tiernan, or equal, with direct reading scale in gpm.

FLUSHING CONNECTIONS

Where called for on the plans, a valved flushing connection shall be furnished. The connection shall consist of a threaded pipe and valve suitable for hookup of a flushing hose. The connection shall be made of 1½-inch diameter pipe or as required by the Owner.

HEATING, VENTILATING AND AIR CONDITIONING

GENERAL

WORK INCLUDED
This work shall include the furnishing and installation of all heating, ventilating and air conditioning systems complete as specified herein, with equipment as listed by Mark number in the Schedule, in locations as shown on the Drawings.

TEMPORARY HEAT
The Contractor shall provide heat, including fuel, and maintain heaters in the buildings under this Contract until they are accepted by or occupied by the Owner with the specified systems in operation.

SERVICE
After completion of the installation, the Contractor shall adjust all thermostats, control valves, motors and other equipment provided under this contract. He shall place them in complete operating condition, subject to the approval of the Engineer.

AIR HANDLING EQUIPMENT

GENERAL
The Contractor shall furnish and install, as shown on the plans, all air handling equipment shown on the plans and specified in this section.

The equipment (units) shall be factory built and factory tested. The manufacturer shall repair or replace any items which fail to obtain specified performance.

The manufacturer shall be ILG, Trane, York, or equal.

All fans shall be statically and dynamically balanced and tested.

Fan ratings shall be based upon tests performed in accordance with the test code set up by Air Moving and Conditioning Association. Each fan shall carry near the manufacturer's nameplate, the seal authorized by AMCA indicating that the ratings are certified.

ELECTRIC UNIT HEATER

An electric unit heater shall be installed in the Pump Room, mounted on a bracket 8 feet above the floor in a location which will not interfere with any other installed equipment. The heater shall maintain suitable temperatures for equipment, maintenance and dehumidification and shall be rated at a minimum of 5 kw. The heater shall be complete with 40°F to 90°F thermostat circulating fan and necessary panel wiring and circuit protection. The manufacturer shall be Trane, ILG, Singer, or approved equal.

DEHUMIDIFIER
An automatic dehumidifier shall be installed in the Pump Room, furnished with sealed compressor and separate fan, having a minimum moisture removal of 3 gallons per day at 80°F and 60 percent relative humidity. Condensation shall be drained to the sump with the coil protected from freezing by a low temperature control. The unit shall be properly mounted for efficient operation and convenient access.

EQUIPMENT LIST

Mark	Location	Quan.	Description	Power
101	Pump Room Retention Basin Dry Well	1	Unit heater, Horizontal electric heater, 17,000 Btuh with: unit mtd. single stage thermostat, Range 40° - 90° F; wall mounting bracket . ILG Model 360-A or equal	5 kW 1/80 Hp 480-3-60
102	Pump Room Retention Basin Dry Well	1	Exhaust fan, Centrifugal, direct drive 500 cfm @ ¼-inch S.P. ILG Type BF-12, or equal	1/4 Hp 115-1-60
103	Pump Room Retention Dry Well	1	Dehumidifier, automatic humidistat control with sealed compressor and separate fan capacity of 3 gallons per day @ 80° F and 60% relative humidity Oasis Model 1500 by Ebco Mfr. or equal	115-1-60
104	Pump Room Retention Basin Dry Well	29-ft.	10-inch diameter duct, from exhaust fan through sleeve in top slab to mushroom vent.	

13. ELECTRICAL

GENERAL

SCOPE OF WORK UNDER THIS SECTION

This work shall be subject to the conditions of the General Equipment Stipulations of the General Requirements and shall include the furnishing of labor, wiring materials, electrical equipment and accessories, erection and testing equipment, tools and services necessary for the complete installation of the electrical systems as shown on the Electrical Drawings and hereinafter specified.

The Contractor shall coordinate with the Power Company the High Voltage and/or Low Voltage metering requirements. Contractor shall furnish, install and connect all metering equipment not furnished, installed or connected by Power Company.

Equipment furnished and installed under this section shall be fabricated, assembled, erected and placed in proper operating condition in full conformity with detail Drawings, Specifications, engineering data, instructions and recommendations of the equipment manufacturers as approved by the Engineer. No equipment shall contain (PCB) polychlorinated biphenyls materials. Special attention shall be given to the General Equipment Stipulations of the General Requirements.

All electrical equipment enclosures shall be NEMA 12 and all conduits shall be ¾-inch minimum unless otherwise noted on the Drawings.

The term Contractor referred to under this section of the work shall mean the Electrical Contractor.

DRAWINGS

The Drawings show the general design, location and intent of the wiring material, electrical equipment and accessories proposed under this Contract. Diagrams, Schedules and construction details are included on these Drawings to aid the Contractor in constructing the work. Exact location for installation of the wiring materials, electrical equipment and accessories must be verified prior to installation with the Owner's representative in the field. Should any structural feature prevent the installation of the wiring materials, equipment and accessories at the location shown on the Drawings, minor deviations therefrom will be permitted, but prior approval must be obtained from the Owner's representative in the field. The work will be done at no additional cost to the Owner.

ELECTRICAL WORK INCLUDED

All electrical work required to complete the work under this Contract excluding that electrical work specified in this section of the Specifications or shown on the Electrical Drawings to be performed under other sections of the work.

RELATED WORK INCLUDED

Excavation, disposal of surplus excavated material, backfill of trenches after conduit is installed.

Furnish, set and secure in proper alignment all required sleeves where conduits pass through walls, floor or roofs of new and existing construction including grouting of sleeves where required.

Furnish and install all supports and anchorages for equipment furnished under this section of the work.

Complete all the demolition work and repair thereof of existing walls and slabs as required for the installation of work under this Section. Items shown shaded on the Electrical Drawings are existing items to remain and items shown crosshatched on the Electrical Drawings are existing items to be removed.

Install and connect equipment furnished under Instrumentation as specified under that section of the work.

Furnish and install electrical manholes and pads.

Furnish and install reinforced structural concrete manholes, equipment pads and vaults.

Furnish and install all conduit encasement concrete, including trenching and backfill.

Verify, with suppliers of equipment furnished under other sections of the work, that all connections done under this section of the work are correct prior to equipment operation.

Touch-up and finish painting of items of equipment furnished and/or installed under this work.

Coordinate the layout and scheduling of this work with related trades, equipment suppliers, Owner and other contractors performing work at the site.

For items indicated as "Field Locate" check Drawings of other trades (in particular piping and structural) for interferences and for location of mounting flanges, connection points, etc.

Storage of equipment furnished under this work as specified herein.

WORK NOT INCLUDED

Furnishing of electrical equipment and control devices which are furnished under other sections of the Specifications are shown on the Electrical Drawings as furnished by others, with special symbols.

Furnishing of electrical motors.

Restoration of roadway, driveway and parking area surfaces, concrete sidewalks, curbs and gutters, lawns and shrubbery will be done under Site Improvements and Restoration Work.

RELATED WORK BY OTHERS
Related work will be done under other sections of the Specifications, including:

Section	12 - Plumbing, Process Piping & HVAC
Section	14 - Instrumentation
Misc.	Equipment Sections

CLEANING
The Contractor shall remove from the Owner's premises the packing material, debris and refuse as it collects due to the performance of his work. The Contractor shall furnish the tools, cleaning materials and labor to clean the wiring material, electrical equipment and accessories he installs so that the building structures and electrical installation shall be left in a clean, neat and finished condition. This shall include the removal of the oil, dust, sprayover, paint, grout or other foreign material from inside and outside equipment enclosures as well as from the wiring materials, equipment and accessories. Cleaning inside the equipment enclosures shall be done at the time of completion of the work and just prior to energization of the equipment. The Contractor shall perform all other cleaning called for under the applicable equipment specifications.

MAINTENANCE OF SERVICE
Disconnecting of any existing circuits shall be scheduled and coordinated in advance with the Engineer's representative in the field and the Owner. Electric service shall be maintained at all times to existing buildings unless arrangements for an interruption are made with the Owner. In such cases the Contractor shall provide a temporary service for the building(s), if required by the Contract.

If after having taken certain electrical equipment out of service temporarily under this Contract, its use subsequently becomes necessary to provide for the safe or emergency operation of the facility, then the Contractor shall return it to service immediately working on a round-the-clock basis if necessary.

GUARDING OF LIVE PARTS
Where there are live parts operating at 50 volts or more, suitable provisions shall be made to avoid accidental contact. Such protection may be secured by restriction of access to the area, or by enclosures or screens. Where probability of physical damage exists, suitable guards of other means shall be provided to avoid such damage.

Clearances. Clearances shall be provided around equipment for working space and around live parts so that safe maintenance and operation may be carried out.

Warnings. In rooms, vaults and similar areas where only qualified persons may enter or where danger of contact with live parts exists, the Contractor shall post warning signs in conspicuous places and as listed below. The signs shall be 12-inches x 14-inches metal with white background and red letters. Signs shall be securely fastened to fencing, equipment or otherwise, using not less than four fasteners of corrosion-resistant material. Voltage warning signs shall be installed for voltages over 600 volts and inscribed:

DANGER - (Phase to Phase Voltage Involved)
For example - DANGER - 4800 VOLTS

Suggested Manufacturers. The equipment shall be the product of one of the following manufacturers, or equal:

Brady
3M Company

SHOP TESTS
Materials shall be tested where specified. Where no tests are specified, materials shall be capable of meeting standard tests and the Contractor shall submit evidence, as the Engineer may require, that similarly manufactured materials have been tested and that they meet the minimum requirements of the tests. The tests shall be certified by the manufacturer.

FINISH
The finish on the wiring materials, electrical equipment and accessories shall provide protection against corrosion by the atmosphere in the environment in which they are to be installed. Both the interior and exterior of enclosures shall be finished.

Non-metal surfaces shall be left untreated if they are of inorganic material but shall be left smooth and free of defects. If they are of organic material, they shall be given a treatment to preserve the material.

Metal surfaces, except contact surfaces, terminals, etc., shall be finish painted as outlined in the General Equipment Stipulations of the General Requirements.

The finish shall be protected from damage during shipping, handling and erection in an approved manner.

Extra paint of each color used shall be provided by the manufacturer for touch-up purposes.

All steel construction hardware and material for outdoor installation and indoor wet locations shall be hot-dipped galvanized after fabrication.

SHIPPING

The Contractor shall obtain permission from the Owner's representative in the field prior to shipping any material to the project site.

Equipment that the Owner is furnishing will be shipped c.i.f. project site.

The Engineer will assist in scheduling delivery of major electrical equipment which the Owner is furnishing in order to minimize storage.

For equipment furnished by the Owner, the Engineer will inform the Contractor of the shipping sections. Hardware required for assembling the sections in the field shall be furnished with the equipment. For equipment furnished by the Contractor, shipping sections shall be subject to the Engineer's approval.

Control wiring, where disconnected at shipping breaks, shall be plainly and correctly marked for field connection. All relays and meters shall have their moving elements blocked during shipping.

All non-drawout equipment shall be normally shipped completely assembled and with all equipment mounted thereon or therein and completely wired.

All drawout equipment shall be shipped separately crated from the enclosure and completely wired with all control and relaying equipment mounted thereon and therein. Drawout elements may be shipped assembled or nonassembled. For Owner furnished equipment, the Contractor shall be informed of the mode in the applicable sections of the specifications. All liquid filled transformers shall be shipped with all radiators and accessories mounted thereon, completely filled.

Handling. Material shall be provided with facilities for lifting, jacking and rolling. The method of rigging and handling shall be of such strength and configuration that no damage to equipment or any injury to person will result. Rigging and handling shall be executed by workmen skilled in the trade.

The methods of rigging and handling shall be subject to the approval of the Owner's representative or of the equipment manufacturer whose material is being handled.

Manufactured material shall be adequately packed to prevent damage during shipping.

When the Contractor handles the Owner's material, the Contractor shall inspect the material prior to removing it from the carrier. If any damage is observed, he shall immediately notify the Owner so that a claim can be made on the carrier. If no such notice is given to the Owner, the material shall be assumed to be undamaged condition; and any subsequent damage to the equipment that appears shall be the responsibility of the Contractor. Repair and replacement of damaged parts will be done at no expense to the Owner.

The Contractor shall be responsible for any demurrage charges resulting from the handling of the materials.

If the equipment requiring storage is being furnished by the Owner, the Contractor shall submit with his proposal a per diem charge for the storage of the equipment. Per diem charges shall be in dollars per cubic foot per day ($\$/ft^3$/day).

STORAGE

When it is necessary to store equipment outside the buildings during the progress of the work, the Contractor shall provide a rigid framework covered with heavy tarpaulines or other equivalent protection over the equipment. Protection shall include heat as required; provision shall also be made to prevent damage from insects, rodents and dust, as approved by the Owner's representative.

Free standing and line-up type equipment for indoor application may be stored outdoors, as specified above. Heat shall be provided either for the entire enclosing framework or for each individual enclosure. Other indoor type of equipment shall not be stored outdoors.

Outdoor free standing and line-up type equipment may be stored outdoors with only heat and mechanical protection.

Liquid filled and sealed-dry type transformers may be stored outdoors with mechanical protection only.

Galvanized material, cast iron, plastic or other non-rusting material may be stored outdoors when protected against mechanical damage.

Cable suitable for installation in wet locations may be stored outdoors provided its ends are properly sealed against moisture and protection from mechanical damage.

Ventilated dry type transformers shall not be stored outdoors or in unheated rooms. The Contractor shall provide all temporary heat required to maintain 50° - 60°F, ambient temperature, in the storage or place of installation until the transformer is energized. Failure to comply with this requirement will require drying of the windings at the Contractor's expense.

CODES, ORDINANCES AND INDUSTRIAL STANDARDS

The design, testing, assembly, and methods of installation of the wiring materials, electrical equipment and accessories proposed under this Contract shall conform

to the National Electric Code and applicable state and local requirements, UL listing and labelling shall be adhered to under this Contract. Any equipment that does not have a UL, FM, CSA or other approved testing laboratory label shall be furnished with a notorized letter signed by the supplier stating that the equipment furnished has been manufactured in accordance with the National Electric Code and OSHA requirements. Any additional cost resulting from any deviation from codes or local requirements shall be borne by the Contractor.

Permits, Inspections and Licenses. The Contractor shall procure all necessary permits and licenses, observe and abide by all applicable laws, regulations, ordinances, and rules of the State, territory or political subdivision thereof, wherein the work is done, or any other duly constituted public authority, and further agrees to hold the Owner harmless from liability or penalty which might be imposed by reason of an asserted violation of such laws, regulations, ordinances or other rules.

Upon completion of the work the Contractor shall secure certificates of inspection from the inspector having jurisdiction and shall submit three copies of the certificates to the Owner.

The Contractor shall pay the fees for the permits, inspections, licenses and certifications when such fees are required.

SPARE PARTS
The manufacturer or Contractor shall furnish a list of recommended spare parts for the material he provides.

Where spare parts are specified to be furnished with the euipment, the manufacturer or Contractor shall provide the specified spare parts as part of his work.

SPECIAL TOOLS, CALIBRATION EQUIPMENT AND TESTING APPARATUS
The Electrical Contractor shall furnish for the Owner's use any special tools, calibration equipment, and testing apparatus required for the proper adjustment and maintenance of the equipment.

The Contractor shall also furnish as part of this contract a multi-meter and clamp-on ammeter probe.

Suggested Manufacturers. The equipment shall be the product of one of the following manufacturers, or equal:

Sencore model FE-27 Multimeter
Simpson model 260-6P Multimeter
Triplet model 630 PLK Type 5 Multimeter
Amprobe model RS-1000S Clamp-on ammeter
A.W. Sperry Instruments, Inc., Model SPR-900A

EQUIPMENT ACCESSORIES
The manufacturer shall furnish all the accessory equipment required for the proper normal operation of the equipment. This does not include supply circuits or other sources of external control power.

The manufacturer shall furnish such equipment as required for routine maintenance of the apparatus such as manual operating handles, devices for moving drawout equipment into its various positions, breaker lifting devices for low voltage switchgear; and close-trip test cabinets for high voltage drawout breakers.

AS-CONSTRUCTED DRAWINGS
The Contractor shall submit, prior to final payment, Drawings conforming to construction records of the systems he has installed. The Drawings shall include the following:

Floor plans (¼-inch scale) showing exact locations of wiring materials, equipment and accessories together with their designations.

Schedules showing terminal numbers at each wiring termination.

The Drawings conforming to construction records shall be prepared by the Contractor, on 22-inch x 34-inch tracing cloth, using the Engineer's symbols and notations. The tracings shall become the property of the Owner.

The manufacturer shall furnish Drawings conforming to construction records covering the material he furnished. They shall be copies of the Shop Drawings required hereinbefore except corrected to constructed conditions. The Contractor who installs the work shall provide marked-up copies of the Shop Drawings for correction by the manufacturer.

SHOP DRAWINGS AND GUARANTEES
Furnish, as prescribed under the General Requirements, Shop Drawings and Guarantees covering the items included under this section of the Contract.

In addition to the above, Shop Drawings for switchgear, motor control centers, conduit layouts, and control panels shall be submitted to include the following Drawings as a minimum package for complete interface checking.

Shop Drawings submitted for approval that do not contain the required Drawings for complete interface checking shall be returned by the Engineer as not approved.

Submittals that are contrary to the design or specifications, that are approved in error, does not relieve the Contractor of his reponsibility for providing the required equipment.

MOTOR CONTROL CENTERS

1. General Arrangement Drawings.
   The above Drawings shall show dimensions, plan view, end view and front panel layout.
   They shall also include the transformer when it is part of the line-up.

2. Schematic Drawings

3. Unit Connection Diagrams.

4. Bill-of-Material List

CONDUIT LAYOUTS

1. Conduit Layout Drawings.
   The above drawings shall show complete power, control, and lighting conduit runs with key sections and terminations identified for each floor of each building where conduit is required to be installed.

CONTROL PANELS

1. Outline Drawings

2. Schematic Drawings

CUTTING AND PATCHING

The Electrical Contractor shall do the necessary cutting for the installation of his work. Cutting shall be done in a neat, workmanlike manner. When using a core drill, concrete saw or other piece of equipment which will cause excessive dust, a portable tent or other suitable protection shall be provided over the work to prevent the dust from spreading to other areas. Patching around openings due to cutting shall be done by qualified workmen of the associated trade. Cost of patching shall be paid by the Contractor.

ANCHORING AND FOUNDATIONS FOR ELECTRICAL EQUIPMENT

Foundations shall be provided for all line-up equipment including motor control centers, switchboards, switchgear, unit substations, high voltage motor controllers and any other free standing equipment. Foundations shall consist of concrete bases with a minimum of two steel channels embedded in them. Where foundations are not shown on the Drawings, they shall consist of a concrete pad 3 inches minimum larger all around than the equipment it supports and shall be a minimum of 4 inches thick above a finished floor.

Steel shall be provided as the manufacturer recommends, or shall be two 4-inch 5.4 lb. U shaped channels for the entire length of the equipment. The channels shall be level over entire length and level with each other.

SUBSTITUTIONS

Where the specifications and drawings state that equipment shall be manufactured by specified manufacturers "or approved equal," the subcontractor shall, at his discretion, submit proposals in the form of shop drawings for alternative equipment that is equal to that offered by the specified manufacturers. The Engineer reserves the right to disapprove this alternative equipment if, in his opinion, it is not equal in quality, durability, appearance, strength, performance, design, physical dimensions and arrangement to the equipment offered by the specified manufacturer.

Where a Subcontractor proposes to use an item of equipment other than that specified or detailed on the drawings that is approved by the Engineer and that requires redesign of the structure, partitions, foundations, piping, wiring, or any other part of the mechanical, electrical, or architectural layout, then such redesign, new drawings, and detailing required for it shall be prepared by the Subcontractor without extra compensation.

Similarly, when a quantity and arrangement of ductwork, piping, wiring, and equipment are required different from that specified or indicated on the drawings, the subcontractor shall provide all ductwork, piping, structural supports, insulation, controllers, motors, starters, electrical wiring, and any other additional equipment required without extra compensation.

Acceptance or rejection of the proposed substitutions shall be subject to the approval of the Engineer. Under no circumstances will the Engineer be required to prove that an item proposed for substitution is not equal to the specified item. If requested by the Engineer or Architect, the Contractor shall submit for inspection samples of both the specified and proposed substitute items.

TRENCH EXCAVATION

EXCAVATION PERMISSION

The Contractor shall call by phone the underground utilities locating service 72 hours in advance before digging, drilling or blasting. When an area does not have an underground utilities locating service the Contractor shall call the local electric, gas and water utilities.

CLASSIFICATION OF EXCAVATION

Earth, as a name for excavated material, shall include all glacial deposit whether cemented or not, except solid boulders one-half cubic yard or more in volume; it shall include all alluvial deposits and material of every kind that can be excavated with equal facility by the equipment and means used for other earth excavation in the work.

Rock, as a name for excavated material, shall include preglacial solid ledge rock that can be removed most practically by blasting, barring or wedging or by some other standard method of quarrying solid rock; it shall include solid boulders of one-half cubic yard or more in volume. It shall include existing concrete, masonry with mortar joints or other existing structural work that can be excavated practically only by methods of quarrying solid rock. It shall not include fragile, friable or disintegrated materials of any kind that can be excavated with equal facility by equipment and means used for earth excavation in this work.

METHOD OF EXCAVATION IN EARTH

All excavation shall be open cut from the surface except in special cases where tunneling under pavement, or structures, may be required, or where tunneling under the root system will be required for tree root protection. All excavation shall be made in such manner and to such depth, length and width as will give ample room for installation of conduit, for bracing, sheeting, and supporting the sides of the excavation, for pumping and drainage of ground water and sewage which may be encountered, and for the removal of all materials excavated. Special care shall be taken so that the soil below the bottom of trenches shall be left undisturbed so that a firm bed will be provided for construction.

METHOD OF EXCAVATION IN ROCK

Every trench in rock must be fully opened for at least 30-feet in advance of any place where conduit is being laid. The rock shall be excavated to a depth of six (6) inches below the conduit and six inches distance on each side.

Where blasting is necessary, this work shall be carried on with due regard for the safety of workmen, pedestrians and private and public property. The method of "covering" blasts, amounts of charges used, and the general procedure of carrying on such work shall be under the supervision of someone thoroughly experienced in handling explosives.

LIMITS OF TRENCH EXCAVATION

Trenches for conduit to be excavated shall be of the width and depth as shown on the Drawings.

The maximum width of the trench at ground surface level adjacent to utility poles shall not be more than the 36 inches on each side of the outside of the conduit.

Trenches shall be at all times of sufficient width to permit the conduit to be laid and first-class construction methods to be used. Sufficient space shall be provided in the trench to permit the joint to be properly made. Joint holes may be provided in the excavation with overhanging sides, provided the material excavated is of such a nature as to make this procedure safe for the workmen. Before excavation is started in either bituminous or concrete paved streets, the paving shall be cut by means of concrete saws or air spades, to a neat and straight line along the top edge of the intended trench opening.

The last six inches of depth of trench in granular material shall be carefully excavated and trimmed by hand to the exact elevation and contour of the conduit. Where the trench excavation for conduit is in rock or clay soil, the trench bottom shall be undercut a minimum of six inches below the final location of the conduit.

STONE REFILL

In locations where the soil at the bottom of the trench is unstable, the Contractor shall excavate below the trench bottom and refill with crushed stone, slag, or crushed gravel equivalent in grading to MDSH Specification No. 6A. Where refill is ordered by the Engineer, the Contractor will be paid by change order to the Contract.

The price for refill shall include the additional excavation and the refill material. Stone placed in the trench by the Contractor in conjunction with and/or in lieu of dewatering the trench and not ordered by the Engineer will not be considered stone refill and will be at the Contractor's expense.

SHEETING, BRACING AND SHORING

Where required to properly support the surfaces of excavations to protect the construction work, adjacent work or workmen, sheeting, bracing, and shoring shall be provided. If the Engineer is of the opinion that at any point sufficient or proper supports have not been provided, he may order additional supports at the expense of the Contractor, but neither the placing of such additional supports by the order of the Engineer

nor the failure of the Engineer to order such additional supports placed shall release the Contractor from his responsibility for the sufficiency of such supports and the integrity of the work. In the removing of sheeting and bracing after the construction has been completed, special care shall be taken to prevent any caving of the sides of excavation and injury to the completed work or to adjacent property.

SHEETING LEFT IN PLACE

Sheeting, bracing and shoring shall not be left in place after completion of the work except as required by the Engineer. Where required to protect the work, adjacent structures or property, sheeting, bracing and shoring shall be left in place but shall be cut off or left no less than two feet below the established surface grade. Sheeting, shoring or bracing so required to be left in place shall be considered as a change in the work.

DISPOSAL OF WATER

The Contractor shall remove by well points, pumping, bailing or other acceptable method any water which may accumulate or be found in the trenches or other excavations to be made. He shall take all necessary precautions to keep the trenches and other excavations entirely free of water during construction of pipelines and structures. Newly laid concrete shall be adequately protected from injury resulting from ground water or sewage or from the handling or disposal of water or sewage. No drainage ditches shall be placed within the area to be occupied by any structure except as permitted by the Engineer.

The Contractor shall at all times have upon the site sufficient pumping equipment ready for immediate use to carry out the intent of this section. All cost for dewatering trenches shall be incidental to the Contract.

CROSSING EXISTING STRUCTURES

During construction, it may be necessary to cross under certain sewers, drains, culverts, water lines, gas lines, electric conduits and other underground structures.

Every effort shall be made to prevent damage to such underground structures. Wherever such structures are disturbed or broken, they shall be restored to good condition. Specified granular fill shall be placed as described hereinafter.

BACKFILLING TRENCHES

GENERAL

Contractor shall refer to the INSTALLATION OF CONDUIT Section on Direct Buried Conduit and Underground Concrete Encased Conduit prior to backfilling.

Backfill shall include all work required to fill in: Trenches as hereinafter specified.

After the conduit has been laid and inspected, the trench shall be backfilled.

All trenches in proposed or existing paved streets, shoulders, traveled roadways, parking areas and driveways shall be backfilled with granular fill from the level one foot above the top of the conduit to a level 10-inches below the finished grade.

Trenches under concrete sidewalks shall be backfilled from a level one foot above the top of the conduit to a level 4-inches below the finished grade of the sidewalk with job excavated backfill and shall be compacted to 95% maximum density.

Trenches in all other areas shall be backfilled from a level one foot above the top of the conduit to the original ground surface with job excavated backfill and shall be compacted to 90% maximum density.

Any depression resulting from settlement of the trench backfill, including resultant roadway surface settlement, for a period of one year after the date of final acceptance of all work under this contract, shall be repaired by the Contractor with no expense to the Owner. Repair shall include backfilling trenches, top soil and seeding and replacement of roadway surfaces.

MATERIALS

Job Excavated Backfill. Job excavation backfill shall be defined as job excavated material, free from frozen earth, boulders, rocks, stones larger than 6-inches in size, debris and organic material.

Granular Fill. Granular fill shall be defined as sharp sand, gravel, or crushed stone, free from lumps of clay, soft or flaky material and shall conform to the MDSH Specification (1970), "Granular materials - Class II" and to the following grading requirements.

Sieve Size	% Passing
2½-inches	100
1-inch	60-100
No. 100	0-30
Loss by washing	0-7

The granular fill shall be placed in not more than 6-inch layers and thoroughly and uniformly compacted by machine tamping with 95% compaction required. With the approval of the Engineer, water jetting may be accepted in lieu of tamping in 6-inch layers for granular fill only.

Material excavated from the trench shall be used as granular fill when in the opinion of the Engineer it meets the Granular Fill grading requirements. Granular Fill hauled in from off the site shall be incidental to the work.

COMPACTION
Specified compaction shall be acquired with the use of a bulldozer, mechanical tamper, or other similar and effective equipment. Specified compaction means not less than 95% (not average 95%) of the maximum unit weight when tested in accordance with the specifications of the MDSH for embankments. If the excavated material is not suitable to obtain 95% minimum compaction the Contractor shall, at his expense, remove unsuitable materials or add granular materials or both to obtain 95% minimum compaction as previously specified.

Compaction tests will be made by a representative of the Owner and paid for by the Owner.

TEMPORARY ROADWAY SURFACES
In all areas where the trench passes through existing roadways, drives or parking areas, the Contractor shall provide temporary roadway surfaces under this section of the work. Such surfaces shall be 10-inches of road gravel, placed in two 5-inch layers and compacted to 95% maximum density. Road gravel shall meet MDSH Specifications No. 22A.

Under this work the Contractor shall maintain temporary roadway surfaces by perodic grading and dust control. No additional payment will be allowed for placing and maintaining temporary roadway surfaces.

BACKFILLING STRUCTURES
As soon as practicable after concrete structures have set, forms and debris have been removed, the surface of the concrete has been pointed up and the structures have been inspected and approved, the excavated area around the structure shall be backfilled up to the specified grade with granular fill or job excavated backfill, as called for on the Drawings for the adjacent trench, and as defined hereinbefore. The fill shall be made in layers not to exceed six inches in dpeth, and shall be thoroughly compacted by machine tamping. No large boulders or masonry shall be placed in backfilling. No backfilling will be placed about manhole walls within 48 hours after the plaster coat has been applied to the outside of the walls nor shall backfilling be placed about concrete structures until the concrete has attained at least 75% of its design strength, and approval of the Engineer has been obtained.

DISPOSAL OF EXCAVATED MATERIAL
Excavated material, where suitable, shall be used in backfilling around conduits and other structures. All material in excess of the quantity required for backfilling or unsuitable material shall be hauled away by the Contractor. Proposed haul routes between the site and disposal areas shall be submitted by the Contractor to the Owner for their approval prior to commencing this work. It shall be the responsibility of the Contractor to obtain such spoil areas as may be required, except that the Engineer may direct the Contractor to dump materials at any site designated by the Owner within a two-mile radius of the work area. The Contractor shall provide all labor and equipment for maintaing haul routes and for spreading such material at the place of dumping and shall leave the area in a neat condition, satisfactory to the Engineer.

CONDUIT MATERIALS

RIGID GALVANIZED STEEL CONDUIT

Where steel conduit is required, it shall conform to ANSI Specification C-80.1. (Electro-galvanized conduit does not meet the requirements of these specifications). At least one coupling shall be furnished assembled with each length of conduit.

PVC Coated Galvanized Steel Conduit. Where PVC coated conduit is required the galvanized conduit prior to plastic coating shall conform to ANSI Specification C80.1 - and be U/L approved as rigid metallic conduit. The exterior of the conduit shall be coated with a heat polymerizing adhesive approximately .0005 inches thick, such as an epoxy - acrylic, prior to plastic coating. The plastic coating shall be bonded to the metal with a thickness of approximately 40 mils for exposed conduit installations and approximately 20 mils for direct buried conduit installations. For exposed conduit, a coupling shall be furnished loose with each length of conduit and shall have a plastic sleeve extending one pipe diameter or 2-inches (whichever is less) beyond the end of the coupling. The inside diameter of the sleeve shall be the same as the outside diameter of the pipe used with it. The wall thickness of the sleeve shall be the same as the plastic coating on the conduit. An air dry vinyl chloride material shall be used as a touch-up compound to fuse the sleeve to the conduit coating. For direct buried conduits, a coupling shall be furnished as part of the conduit. The opposite thread shall not be coated but protected with a thread protector. The bond between metal and plastic shall be equal or greater than the tensile strength of the plastic coating. The plastic coating shall be a self-extinguishing type material. The conduit while being stored prior to use shall be kept out of direct sunlight. Once the conduit system is installed, the manufacturers standard touch-up compound shall be used to patch up gouges or bare metal.

LIQUID-TIGHT CONDUIT

Where liquid-tight conduit is required it shall be flexible conduit coated with a permanently bonded PVC which passes the tests of the IPCEA. It shall be supplied in standard manufacturer's lengths with married liquid-tight fittings at each end meeting NEMA and U/L requirements.

Suggested Manufacturers. The liquid-tight conduit shall be the product of one of the following manufacturers, or equal:

Electric-Flex
Pittsburgh Standard
Sealtite

NON-METALLIC CONDUIT

Where non-metallic conduit is specified it shall meet or exceed the standards of both quality and installation as set forth in the "latest edition" at time of bidding the following:

National Electrical Code - Article 347
National Electrical Manufacturers Association Pub. No. TC-6
National Electrical Manufacturers Association Pub. No. TC-2

Underground PVC Duct. Underground PVC duct shall be used only for concrete encased burial applications and must meet NEMA TC-6 and be U.L. listed. All joints shall be cemented with a "brush type" cement. Use spacers manufactured for PVC in concrete applications with provisions for anchoring to prevent the duct from floating during pouring of the cement.

CONDUIT SLEEVES, BOX-OUT FRAMES
The Contractor shall furnish and install, at all points where conduits pass through floors, walls, or roofs of structures, suitable sleeves or box-out frames.

Sleeves and box-out frames shall be set in proper alignment and secured to maintain alignment during construction of the structure.

Sleeves and box-out frames shall be installed flush with walls and the underside of poured slabs, but shall extend one inch above finish floors and shall extend above roofs as required to prevent submergence.

The space between conduits in box-out frames shall be sealed with non-shrink grout.

Sleeves containing a single conduit shall be caulked with hot lead or hot lead wool. Hot lead when used shall be applied before installing wire in conduit.

Sleeves and box-out frames shall have a welded flange all around to prevent moisture seepage and shall not be painted when used in poured concrete but shall be cleaned of all rust, scale, dirt, grease, etc., before installing.

Sleeves may be installed in interior or exterior floors and walls, except they shall not be used in exterior walls below grade.

Box-out frames may be installed in interior floors and walls only.

Conduit sleeves and box-outs are not required in outdoor pads or slabs.

Compression type seal fittings shall be used on all below grade conduits passing through exterior walls.

CONDUIT JOINTS
Where conditions require joining two fixed conduits into a continuous run, a conduit union, shall be used in place of running threads and coupling. Expansion joints shall be used at building construction joints and in long conduit runs subject to thermal expansion and contraction. Expansion joints shall have cast iron end fittings, steel conduit bodies and NEC approved bonding jumpers.

Conduit Bushings. Conduit bushings shall conform to requirements hereinafter for "Conduit Access Fittings" for material and finish. A thermo-setting insulating insert shall be permanently fixed to the interior surface of the bushings. Where grounding bushings are required, the bushings shall have an integrally cast tapped hole for holding the bonding connector.

CONDUIT FITTINGS
The fittings required for this work are shown on the Drawings or called for in the Specifications. They shall be designed for use with the specific type of raceway and/or cable involved. Whenever special construction is required, Shop Drawings shall be submitted for the Engineer's prior approval before fabrication. Aluminum fittings shall be used with aluminum conduit but not elsewhere. All raceway fittings used in explosion proof areas as defined in NEC Article 500 shall conform to the NEC Articles 501 to 503 inclusive. Conduit systems shall have fittings as required by the Drawings and Specifications and where required in the installation by good practice. Fittings shall be suitable for the application and designed for the purpose for which they are used.

Rigid Steel Conduit Fittings. Hot-dipped galvanized fittings and parts shall be used. Stamped steel fittings or boxes shall not be used unless specifically shown on the Drawings or called for in the Specifications. Covers shall be stamped metal with gaskets in dry locations, cast metal with neoprene gaskets for wet or damp locations, below grade and outdoors. For hazardous locations, threaded or ground joint type covers shall be used.

Conduit Access Fittings. Conduit access fittings shall be Form 8 of Crouse-Hinds, Form 35 of Appleton or Form 5 of Pyle-National (or equal) for 1-inch or smaller conduit and Mogul type for larger conduit. They shall be made of cast or malleable iron, cadmium plated or hot-dipped galvanized. Threaded hubs shall be used.

CONDUIT BOXES
The boxes required for this work are shown on the Drawings or called for in the Specifications.

Outlet Boxes. Flush-mounted or surface mounted outlet boxes, for poured concrete walls or ceilings shall be made of cast or malleable iron, hot-dipped galvanized or cadmium plated. Flush type boxes shall have a flange for securing boxes to concrete forms. Surface type boxes shall be provided with mounting lugs.

Flush-mounted outlet boxes for concrete block walls and/or tiled surface walls, above grade only, shall be stamped steel, hot-dipped galvanized type boxes. Stamped steel boxes shall not be used for surface mounting applications.

Hub covers shall be provided for all outlet boxes and shall include extra long hub cover mounting screws when required.

Outlet boxes shall not be used except as outlets.

Device Boxes. Flush-mounted or surface-mounted device boxes, for pourced concrete walls shall be made of cast or malleable iron, hot-dipped galvanized or cadmium

plated. Flush-type boxes shall have a flange for securing boxes to concrete forms. Surface type boxes shall be provided with mounting lugs.

Flush-mounted device boxes for concrete block walls and/or tiled surface walls, above grade only, shall be stamped steel, hot-dipped galvanized or cadmium plated. All devices installed in flush-mounted device boxes shall be provided with plaster ears for seating on finished wall surfaces.

Extra long device mounting screws and oversize wall plates shall be provided when required for supporting the devices in boxes.

Stamped steel boxes shall not be used for surface mounting applications.

Gang type boxes and covers shall be used where more than one device is to be mounted at the same location. Where wiring devices are used, covers shall match wiring device.

Junction and Pull Boxes. For rigid steel conduit systems, FD or other condulets shall be used as junction or pull boxes provided the cable fill and cable bending radius are not exceeded and NEC requirements are met.

All junction boxes and pull boxes used in damp locations, outdoors, or below grade shall be hot dipped galvanized or cadmium plated cast type boxes with watertight rubber gasketed covers.

Suggested Manufacturers. The equipment shall be the product of one of the following manufacturers, or equal:

Conduit Fittings	Expansion Fittings
Appleton	Crouse Hinds
Crouse Hinds	O.Z.
Pyle-National	

INSTALLATION OF CONDUIT

Each circuit to a motor, transformer, etc. operating at more than 120 volts to ground shall be provided with a separate conduit, isolated at all points from other circuits, except as follows. Where control circuits are associated with motor circuits they may be run in the same conduit with No. 8 and smaller motor circuit conductors. Where No. 6 and larger motor circuit conductors are required the control circuits shall be run in separate conduits.

Each item of equipment operating at 120 volts or less shall be provided with a separate conduit to the destination shown, except as defined below.

1. Multiple Equipment Requirements
   a. When more than one item of equipment is assigned to the same circuit, having the same panelboard destination, these items may be run in the same conduit. (Does not include destinations to control panels.)

2. Lighting Receptable Requirements.
   a. Three lighting circuits assigned to phases A, B, C of the same panelboard may be run in the same conduit.
   b. Three receptacle circuits assigned to phases A, B, C of the same panelboard may be run in the same conduit.
   c. Lighting circuits and receptable circuits shall not be run in the same conduit.
   d. Emergency lighting circuits shall be provided independent conduits as required by the NEC.

3. Instrument Equipment (Power Requirements)
   a. The power for the three items of instrument equipment assigned to the same panelboard may be run in the same conduit, except as follows: when two or more items of equipment serve the same type of function, such as Two Return Sludge Meters, or Two Raw Sewage items, etc., each one shall be run in different conduits.

4. Instrument Equipment (Signal Requirements)
   a. The signal wires for the 3 items of instrument equipment assigned to the same control panel may be run in the same conduit, except as follows: when two or more items of equipment serve the same type of function such as Two Return Sludge

Meters, or Two Raw Sewage items, etc. each one shall be run in different conduits.

b. Instrument power circuits and signal circuits shall not be run in the same conduit.

No exceptions shall be taken to the above rules by the Contractor, unless they are specifically shown on the Drawings or called for in the Specifications. Where pulling points are required in multiple conduit runs, conduit fittings for each run shall be used. Pullboxes shall not be used unless called for or approved. Minimum conduit sizes shall be ¾-inch.

Where called for on the Drawings, spare conduits are required down to the basement and up through the roof. Provide an FSX junction box for each spare conduit just below each ceiling elevation on single and multilevel structures including the basement. Orient the junction boxes to assure future use of spare openings and cap. Where panelboards are located directly above one another on different floors, the same spare conduits are to serve each such panelboard.

Spare conduits may be required in the same manner for each Motor Control Center. Stub-out and cap the spare conduits in the basement just below ceiling level, and just above the top floor elevation. Provide an FSX junction box for each spare conduit just below each ceiling elevation on single and multilevel structures including the basement.

Raceways shall be rigid galvanized steel conduit, surface mounted unless otherwise shown on the Drawings or in the Specifications.

Mount conduit with malleable clamps. Spacers between the conduit and mounting surface shall be used on all cement, tile and metal surfaces.

Liquid tight flexible metal conduit shall be used for connections to motors, transformers, etc. where vibration or movement at the raceway will occur. Lengths no shorter than 18 inches or longer than 6 feet shall be used.

Conduit shall be connected to couplings, bushings, nipples, hubs, etc. by American Standard pipe threads. Running threads, set screw couplings, or other joint methods shall not be used. Chase nipples or running thread nipples shall not be used. Joints shall be made watertight by coating all threaded portions with zinc bearing paint and drawing up joints mechanically tight at the threads. Where conduit is cut and field threaded, it shall be cut square, reamed smooth and threaded to American Standard Pipe threads. Where joints are to be made in two fixed conduits, a conduit union shall be used.

Conduit shall be clean and kept sealed until conductors are installed. Spare conduit above grade shall be capped with a bushing and "penny" or other approved means. Spare conduit below grade shall have a coupling and drain fitting installed. Conduit systems shall in general be watertight at all joints to prevent the entrance of moisture and shall be drained to relieve any accumulated moisture.

Whenever practicable, all metallic conduit shall be kept clear of cinder fill. Where necessary to run metallic conduit in or under cinder fill, the conduit shall be protected on all sides by a sand-cement enevelope having a minimum thickness of three inches. When installing RGS conduit, care shall be exercised to avoid tool marks, surface burrs, etc. When installing PVC coated conduit, hand dies for threading conduit, which do not have an expandable pilot or follower, should be bored out approximately .100-in. to accommodate increased diameter of PVC coated conduit. For bending PVC coated conduit a bender one size larger than for uncoated conduit shall be used. Strap wrenches are recommended for installing conduit. Wrench marks or chuck marks in PVC coated conduit after installation shall not be accepted.

CORING AND GROUTING

Where conduits installed under this Section of the work pass through structural concrete in which no sleeve has been provided, the Electrical Contractor shall drill and grout in a casting or sleeve for that conduit. Castings and sleeves shall be installed as specified above under that subheading.

Before drilling any structural concrete, the Electrical Contractor shall obtain the Engineer's approval. Any cutting or reinforcing steel by careless or unnecessary drilling by the Electrical Contractor shall require that the structure be returned to a condition comparable to that which it had before drilling was done at the Electrical Contractor's expense.

EXPOSED CONDUIT INSTALLATION

The actual routing of exposed conduit inside a building shall be reviewed with the Owner for approval prior to doing the work. Conduit shall not be installedon exterior surfaces of buildings unless otherwise shown on the Drawings or approved by the Engineer.

Exposed conduit shall be installed neatly in horizontal and vertical rows parallel to inside building lines. Horizontal rows intalled on walls, shall not be located close to the floor, or midway of the wall, but shall be located as close to the ceiling as practical, unless otherwise shown on the Drawings or approved by the Engineer. Offsets and bends in all common runs are to be matched to give a uniform appearance.

Exposed conduit shall not be run diagonally across panels, ceilings, or open space. Individual conduits shall be run as straight as possible with special attention given to arrangement to insure adequate working space around equipment and in access areas. Conduits in the same vicinity shall be grouped when possible and arranged to minimize crossovers.

Conduit entry to all motor control centers and main control panels shall be installed from the bottom through floor chase openings unless otherwise shown on the Drawings.

The following type conduits shall be installed in area's as defined below.

(a) Rigid galvanized steel (RGS) conduit shall be installed in dry areas only.

(b) PVC coated galvanized steel conduits shall be installed in all wet wells and other high moisture laden areas completely watertight. Conduits exiting vertical walls of wet wells, shall be through compression type sleeves near top of wet well.

(c) Conduits exiting vertically from underground, on the outside of building structures or at riser poles, shall be PVC coated rigid galvanized steel conduit for full length of exposed conduit.

CONCEALED CONDUIT INSTALLATION

Where concealed conduit is required, it shall be installed in concrete prior to pouring and in masonry as it is being laid. Conduit concealed in concrete shall be secured to the forms in proper position before the concrete is poured. The outlet and junction boxes shall be secured in such a manner that the covers of all boxes shall be flush with the final finish of the walls, ceilings and floors. The conduit, boxes and fittings shall be secured in such a manner that they are not disturbed while the concrete is being poured or the forms are being removed.

Conduit installed in concrete as straight runs shall be either PVC conduit or PVC coated galvanized steel conduit. Expansion/deflection couplings shall be used at all concrete joints, between the two sections of concrete. Couplings shall be provided for a linear misalignment of ¾-inch from normal in all directions and for angular misalignment of 30° from normal in any direction. All conduit exiting from concrete shall be PVC coated galvanized steel conduit.

In finished offices, conduit shall be run in furred space or concealed in the building construction. Outlet boxes and fittings, unless securely held in place by masonry, concrete or other building materials in which they are embedded, shall be securely fastened to a structural member. Lath and composition or plaster boards shall not be considered as structural members. Conduit runs above suspended ceilings shall be supported as outlined in exposed conduit construction hereinbefore.

INSTALLATION OF CONDUIT FITTINGS

Accessory equipment shall be provided as required. Pull fittings or pull openings shall be provided in the conduit runs as follows: Pull openings may be spaced up to 200 ft. apart for straight runs; Pull openings may be spaced up to 150 ft. apart for included bends between openings up to and including 90° Pull openings may be spaced up to 100 ft. apart for included bends between openings greater than 90° but not exceeding 180°; Pull openings may be spaced up to 50 ft. apart for included bends between openings greater than 180° but not exceeding the code. Outlet boxes shall be provided where required for raceway terminations. Changes in direction shall be made with elbows, offsets (factory standard or field made) conduit fittings and pull boxes. Factory bends and offsets shall be used where the radius of the inner edge is not less than the recommended bending radius of the cable, or match bends and offsets are not required. Field bends and offsets shall comply with NEC for bend radii. For 2400 volt and higher systems the minimum inner edge radius allowage is 24 inches. Conduit fittings shall not be used for cable rated over 600 volts. For cable rated over 600 volts, changes in direction shall be made with offsets, bends and pullboxes. When expandable seal conduit wall sleeves for cable rated over 600 volts, enter a pullbox, cutouts shall be provided in the pullbox, exposing the entire end of the sleeve. The pullbox shall be mounted with spacers as close to the wall as practical and be provided with a drain, piped to the floor.

Multiple conduit pullboxes for all voltages shall not be used unless specifically shown on the Drawings.

Double locknuts shall be provided at all junction box enclosure and cabinet entrances with threadless openings. Insulating grounding bushings should be used to terminate conduit runs at an enclosure, bushings shall be galvanized.

Expansion/deflection joints shall be used at all concrete joints which a conduit passes through or where conduits are attached to two structures joined by a concrete joint and shall be capable of providing a minimum ¾-inch movement from the normal in all directions and angular misalignment of 30° from normal in any direction.

Fitting Supports. Enclosures with threadless openings, used as pull or junction boxes shall be supported independently of all conduit, except that FD or other conduit boxes used as junction and pull boxes may be supported by the conduit system provided five full threads are engaged.

Box supporting methods shall be as follows:

1. In concrete, boxes shall be located accurately and anchored securely to reinforcingsteel and to forms to prevent their shifting when concrete is poured. Provide spacers between the box and concrete surface.

2. In furred ceilings, outlet boxes shall be rigidly fastened to the supporting structure by an approved type bar hanger or support.

3. On hollow tile or similar surface, toggle type bolts shall be used to secure outlet boxes in place. Provide spaces between the box and the tile surface.

4. On building steel, boxes shall be fastened by approved clamp type, vibration-proof supports with spacers between the box and steel surfaces.

5. On concrete or brick surfaces, boxes shall be rigidly fastened by proper sized machine bolts and approved type expansive shields. Where fastened directly to building steel, they shall be clamped. Provide spacers between the box and the mounting surface.

6. Junction or pullboxes suspended from building steel shall be supported by round steel rods securely fastened to structure with beam clamps. Where suspended from concrete or wood, boxes shall be supported by round steel rods securely fastened to the structure through hangers.

7. Where junction or pullboxes are to be installed inside the web of building columns, they shall be supported with Unistrut, Powerstrut assemblies or equal.

8. Minimum permissible diameter of steel rod for hangers and supports is 3/8-inch.

TRENCH MARKING

Direct buried conduit installed in trenches shall be marked by a one inch thick concrete ribbon or a strip of yellow marking tape. The marker shall be placed a minimum of 12 inches below grade during backfilling of the trench. The concrete ribbon shall be painted with a yellow stripe 6 inches wide. The tape shall be highly acid and alkalie resistant polyethylene film 0.004 inch thick, 6 inches wide with lengthwise and crosswise shear strength of 1500 psi minimum.

The tape shall read "CAUTION BURIED ELECTRICAL LINE." The wording shall repeat every 12 to 18 inches minimum.

Suggested Manufacturer. The tape shall be the product of one of the following manufacturers, or equal:
Brady
3M Co.

UNDERGROUND CONCRETE ENCASED CONDUIT

Contractor shall refer to the section "CONDUIT TRENCH EXCAVATION AND BACKFILL" prior to installing conduit.

Where shown on the Electrical Drawings, electrical conduit shall be encased in concrete. Conduit to be encased under slabs resting on disturbed earth shall be anchored to and supported from structures above by steel bar hangers placed around the pipe, embedded in the encasement and anchored into the concrete work above. Hangers shall be ½-inch bars spaced not over three feet apart and shall be furnished and installed under this section of the work.

Concrete shall be Class A 4000 psi strength. It shall be placed in the trench with a chute or "truck" and directed along the conduit run so as to avoid displacing the conduit. Voids and spaces shall be removed by tamping or with mechanical vibrators.

Conduit to be encased shall be supported on approved spacers at the dimensions shown on the Drawings. The entire assembly of conduit to be encased shall be banded together with 5/8-inch wide banding iron and staked to the ground to prevent flotation during encasement. If the trench is wider than the encasement, forms shall be provided at the sides for support until the concrete has set. The Contractor shall not fill the entire trench with concrete but shall confine the concrete to the limits shown on the Drawings.

For concrete encased conduit, the trench shall be sloped a minimum of 0.5% to allow drainage to structures or as shown on the Drawings. A clearance of 12-inch minimum shall be maintained between encasement and yard piping, except at crossings. Care shall be taken to avoid any depressions, pockets or other moisture traps when grading trench bottom. The trench shall be dug to allow 24-inches clear from the top of the encasement to finish grade when conduits contain high voltage circuits.

There shall be clearance between ducts in the same run and thickness of base as shown on the Drawings. The clearance and thickness of base shall be obtained by using one plastic spacer every five feet along the conduit formation. Spacers shall be used both horizontally and vertically as required.

Careful attention shall be given in placing the concrete encasement. Ducts shall be plugged to prevent seepage of concrete, water or dust into them.

Reinforcing steel shall be placed in conduit structures when so required and as indicated on the Drawings. Concrete for conduit structures shall be as specified herein under Cast-in-Place Concrete. Prior to cable installation, each conduit shall be mandrelled using a non-metallic mandrel no more than 1/4-inch smaller than the inside diameter of the duct. It shall be followed by a wire brush. A swab shall then be pulled through to clean out any loose dirt and other foreign material.

Where ducts containing non-metallic conduit enter buildings, provide transitions to steel conduits of same size and provide a drain fitting and water seal in each conduit at point of building entry.

WIRING MATERIALS AND METHODS OF INSTALLATION

GENERAL

The wiring materials and methods specified herein shall be used unless noted otherwise specifically on the Drawings or elsewhere in the Specifications.

INSTALLATION OF WIRE AND CABLE

Wire and cable shall be installed in such a manner as to maintain the integrity of conductor, insulation, shielding and finishes. Wire and cable shall not be bent or kinked to a smaller radius than approved by the manufacturer and in no case in a smaller radius than six times its diameter. The pulling tension placed on the wire or cable shall not exceed the permissible maximum allowed by the manufacturer.

Cable ends shall be kept sealed until ready to splice or terminate in a manner suitable for the type cable involved. Cable shall not be installed, pulled or handled at ambient temperatures below those allowed by the cable manufacturer. All pulling shall be done by use of pulling eyes attached to all conductors which make up the cable, unless otherwise approved by the Engineers. Wiring shall not be installed in raceways until it can be terminated in equipment.

Installation of Wire and Cable in Equipment Enclosures. Wire and cable shall be brought into enclosures at the nearest point to the terminals to which they are to be attached. All wire and cable in enclosures shall be supported such that no strain is placed on the terminals to which they are to be attached. Wires entering a common raceway shall be bound together with nylon ties until they arrive at their respective terminals. Metal clamps or ties shall not be used to bind unjacketed cable. Enclosures shall not be used as pullboxes, junction boxes or raceways. Only wire and cable which is to be terminated in an enclosure shall enter that enclosure and shall not be spliced before termination.

Cable jackets shall be removed from multiconductor control cables only to the point necessary to terminate the individual wires. Wire and cable shall be placed in the enclosure in such a manner as to leave access to all areas, parts, terminals or other points which require removal or use in maintenance operations. Power and control conductors shall remain separated in enclosures unless they must be routed to common raceways or terminals.

Cable ends shall be sealed in wet locations, control cable shall be trained in a definite route, arranged in bundles, laced together with heavy insulating cord and supported throughout its run with rubber bushed fittings.

Installation of Wire and Cable in Conduit. Where it is required to install wire or cable in conduit the following precautions shall be observed. When a lubricant is used to relieve pulling tension for cable it shall be non-conducting type compatible with the insulation or jacket material of the cable and shall not gum, harden or cement the cable to the conduit. Petroleum base lubricants shall not be used with nonmetallic conduit. Splices or terminations shall not be made in or pulled into conduit.

Before pulling cable into conduit encased in concrete or buried in earth the Contractor shall pull through a plug approximating the diameter of the opening, followed by a circular wire brush. Swabs shall then be pulled through to clean out any remaining dirt. In nonmetallic conduit, "fish tape" shall be only of plastic or round flexible steel, and only plastic or manilla rope shall be used for pulling in cable. All wires in a given conduit shall be installed as a group. No additional wires shall be pulled into a conduit after the initial installation unless it is an existing conduit specifically shown to be used in this manner.

Each and every pulling fitting and/or pulling point shall be used when pulling wire or cable.

CIRCUIT IDENTIFICATION

Circuit identification shall be placed at termination points, splices or junctions in each circuit. The identification shall be applied around the conductors where possible, or to exterior permanent enclosures where necessary. The circuit labels shall conform to those on the Drawings. All low voltage circuits of No. 2 AWG and larger size shall be identified by metal tags fastened tightly with locking, wrap around nylon ties. All other low voltage circuits shall be identified with printed adhesive tape tags. All power cables of circuits above 600 volts shall have tags of 1/8 inch thick sheet lead 3-inches x 3-inches in size with ears at top and bottom and bound to the cable with No. 12 minimum copper wire. Tags shall be stamped with ¼-inch high letters to indicate:

1. Cable name or number.
2. Size of cable and single or three conductor.
3. Insulation class of cable (add GN if grounded neutral).

The phasing of conductors operated at 601 volts or higher shall be marked at all terminations (1,2,3), (X,Y,Z) or (A,B,C) as per Owner's method of phase designation. Marks shall consist of 1½-inch to 2-inch high letters neatly painted using a stencil or mask on the cable supports nearest to connections, terminals or elsewhere in an easily visible location but in all cases so placed as to positively identify the phase. Where called for herein or on the plans they shall be painted on the back sheet or door through which access to the terminals is made. Where potheads are used phasing shall be painted on the pothead body. Where painted marks are not practicable a permanent lead tag as specified above shall be attached to the shielded conductor.

Circuit identification tags shall be supplied for all circuits inside manholes.

Suggested Manufacturers. The equipment shall be the product of one of the following manufacturers, or equal:

WIRING MATERIALS
- 3M Company
- Plymouth Rubber Co.
- ITT-Blackburn

WIRE MARKERS
- Brady
- Westline
- Thomas & Betts

CONNECTORS
- Burndy
- Thomas and Betts

GROUNDING MATERIALS AND METHODS OF INSTALLATION

GROUNDING

Equipment and system grounding shall be provided in accordance with the National Electrical Code as a minimum. Any additional work shall be called for in the Specifications or shown on the Drawings.

Each building with service equipment shall have a grounding system. The grounding system shall be either a continuous underground metallic piping system of satisfactory construction for the purpose or where made electrodes are called for they shall be constructed as follows: Where such a system is to be used it shall be tested by the Contractor in accordance with "Testing" hereinafter, and the result submitted to the Engineer for his determination as to the suitability of the system.

GROUND RODS

Ground rods shall be solid cylindrical rods of copperclad steel, tinned at the top connection. Dimensions shall be as shown on the Drawings.

GROUND MATS

Ground mats shall be constructed of ground rods driven to a depth of 2-feet below finished grade minimum. The number of ground rods, spacing and arrangement shall be as shown on the plans. The ground rods shall be interconnected with No. 4/0 AWG cable minimum to form a ground grid. From the ground mat at least two risers will be brought for connection to equipment and other locations shown on the Drawings. The maximum resistance shall be 5 ohms. Ground rods shall be driven in undisturbed earth.

GROUNDING CABLE

Grounding cable shall be bare soft drawn copper. It shall be No. 4/0 AWG unless shown otherwise on the Drawings or called for otherwise in the Specifications. Where equipment grounding conductors are required they shall be sized according to Article 250 of the National Electrical Code, minimum. Equipment grounding conductors shall be provided even when not shown on the Drawings when they are required by the National Electrical Code or other applicable codes. Grounding cable shall be insulated where shown on the Drawings. Insulation shall be identical to the power conductor insulation. Equipment grounding conductors shall be provided for all feeder circuits even if such feeder circuits are contained in grounded steel raceways. Equipment grounding conductors for feeder circuits are contained in grounded steel raceways. Equipment grounding conductors for feeder circuits shall be attached to the ground busses at both pieces of equipment, shall be continuous from ground bus to ground bus and shall be bonded at both entry to and exit from any grounded steel raceways in which they are contained.

GROUND BUS

Ground bus shall be copper 1/4-inch x 1-inch in size minimum.

EQUIPMENT TO BE GROUNDED

In addition to the equipment on the Drawings which is shown grounded the following items shall be grounded as stated:

A. Main and building service equipment shall have its ground bus attached directly to the grounding electrode by two main grounding conductors sized per Article 250, minimum. Where building service equipment is served from the main service equipment the ground busses shall be tied in accordance with Grounding Cable herein. Equipment in this category includes:
   1. Metal Clad Switchgear
   2. Metal Enclosed Switchgear
   3. Motor Control Centers
   4. Switch boards
   5. Distribution Panelboards

B. Auxiliary equipment shall be grounded to the ground bus of the equipment with which it operates. Equipment in this category includes:
   1. Power transformers which are integral construction with switchgear.
   2. Batteries used for control power of switchgear or motor controls.
   3. Potential, control power and current transformers which derive their power from the equipment.

C. Equipment which contains or is served by circuits emanating from distribution equipment shall be grounded to the distribution equipment ground bus with an equipment grounding conductor sized per NEC Article 250, minimum. Equipment in this category includes:
   1. Conduit or other raceways (use grounding bushing and jumper).
   2. Lead sheath and insulation shielding of high voltage cables.
   3. Frames of all motors shall have a separate grounding conductor in conduit even if circuit is in grounded steel raceway.

INSTALLATION OF GROUNDING EQUIPMENT

Connections between ground rods and cable shall be made with heavy duty exothermic process or compression type connectors. Contact surfaces shall be cleaned prior to connecting. Compression type connectors shall be submitted to the Engineer for approval.

Ground cable and risers shall be continuous from end to end. Taps may be made if necessary. Taps and splices shall be made by exothermic process or compression type connectors approved by the Engineer.

Exposed ground cables and straps shall be run parallel with building lines and shall be adequately and neatly supported to prevent sag and possible damage. Routing is subject to approval of the Owner.

All grounding cable and bus, where it may be subject to mechanical damage, or where shown on the Drawings, shall be protected by rigid metal conduit, steel angles or channels. Such protective means shall be grounded to the conductor at both ends. Where grounding cable passes through floors, it shall be in rigid metal conduit. Where installed in metal conduit it shall be bonded to the conduit at both ends.

GENERAL

The equipment specified hereinafter may be used individually and/or as part of an assembly of equipment. The respective Specifications herein apply to any device operating at 600 volts or less, whether part of an assembly of 600 volt equipment or an individual piece of equipment.

Where motor control centers, distribution panelboards, lighting panelboards, control boxes and all multi-device or individual device enclosures are used, they shall be suitable for the environment. For structures above ground which are dry, heated and ventilated and contain no industrial type chemicals or chemical equipment, NEMA 12 enclosures shall be used unless otherwise shown on the Drawings. For structures below grade NEMA 4 or NEMA 4X enclosures shall be used. For all hazardous locations where shown on the Drawings, NEMA 7 enclosures shall be used. For chemical areas, NEMA 4X shall be used (see chemical room spec.). For outdoor locations NEMA 4 shall be used.

The Contractor shall coordinate the feeder breakers, main breakers and primary fuses with final load values from the coordination study.

MOTOR CONTROL CENTERS

Where motor control centers are required, they shall be UL labeled and conform to NEMA class II, type B standards. Incoming line shall enter the motor control center as shown on the Drawings.

For service entrance switching applications where the Motor Control equipment is not approved for Service Entrance Equipment the Contractor shall furnish an approved disconnect switch in a separate enclosure.

The motor control center shall consist of independent vertical sections housing the equipment hereinafter specified and shown on the Drawings. It shall be free standing with the sections bolted together to make up the center. A section shall be 90-92 inches overall height including any mounting sills. The width of each section shall be 20 inches and the depth 20 to 21 inches except where otherwise noted. Each section shall be dead front and rear access shall not be necessary for connections. Removable rear plates or hinged doors with lockable latches shall, however, be employed on the rear of each section. The bottom of each section shall be left open for conduit stubs. The top of each section shall have removable plates for access to the horizontal feeder bus and for conduit entry. Front, rear and side cover plates shall have formed edges so that no sheared surfaces are exposed. A minimum of No. 14 gauge sheet steel shall be used throughout the structure including doors and cover plates. Steel housing parts, both inside and out, shall be given a rust-inhibiting phosphatizing treatment and finished with baked enamel or epoxy base paint. Full length removable lifting angles shall be provided for equipment handling.

Pan type doors shall be used for units and future spaces. Doors shall be hinged to the structure with full length, piano type or two point concealed hinges and fastened with pressure type fasteners. The doors shall have neoprene gaskets and external operating handles. Each unit in the motor control center shall be interlocked with the door so that the door cannot be opened when the external operating handle is in the "ON" position. A screw operated defeat mechanism shall be provided. The external operating handle on each unit shall have provision for padlocking in the "OFF" position with capacity for three padlocks. Within each section each unit shall be isolated by complete steel top and bottom plates.

Each section shall contain a main horizontal bus of three aluminum or copper bus bars, which shall run continuously through the center from section to section. Provisions shall be made for easy addition and connection to adjacent sections. Aluminum bus shall be tin plated over its entire length. The temperature rise above ambient shall not exceed 50°C in accordance with NEMA procedures. Horizontal bus shall be sized as shown on Drawings with minimum rating of 600 amp. Cable connections between sections shall not be acceptable. The horizontal bus shall be braced to withstand the RMS symmetrical fault current shown on the Drawings. The bus supports shall be formed of high dilectric strength, low moisture absorbing, high impact material with ample creepage distance between bus bars.

Each section shall contain three vertical bus bars running the full working height of the section and connected to the main horizontal bus bars. The vertical bus shall have 300 amp capacity minimum. The vertical bus bars shall be braced to withstand the same symmetrical fault current as the main horizontal bus. The bus supports shall be formed of material of high impact strength and so designed as to discourage the collection of dust or other foreign material. Vertical busing shall be separated from the unit compartment by a sheet metal or glass filled polyester barrier extending the full height of each section.

A copper ground bus shall be provided in all sections of the center and shall be continuous throughout. It shall be effectively connected to all non-current carrying parts of the center and shall leave lugs for connection to 4/0 copper cables at each end.

Each section shall have a top horizontal wiring trough in front of the main horizontal bus and a similar wiring trough in back of the horizontal bus in 20-inch depth back to back structures. This wiring trough shall be protected from the horizontal bus bars by a means of a steel barrier plate. The wiring trough shall be equipped with cable supports and the structure shall have an opening in the end for continuous cable runs through the motor control center.

A vertical wiring trough shall run the full working height of each section and shall be equipped with cable tie clamps. This vertical wiring trough shall be designed so as to allow installation wiring to the units with the units in place. A minimum of three inches access between the unit terminal blocks and the side of the structure should be provided for the vertical wiring trough.

Units shall connect to the vertical bus bar in each section with stab-on power plug connectors on the back of the unit. The stab-on connectors shall be free floating tin or silver plated clips, self-aligning and backed up with steel springs. (Size 4 starter units and larger may be bolted in). They shall be capable of being withdrawn from the structure without disturbing adjacent equipment. Unit support brackets shall be provided in the structure to properly align the units.

Branch circuit disconnects shall be the general-use fusible switches, or molded case distribution circuit breaker type as shown on the Drawings. The branch circuit switches, breakers, and the main disconnect means shall have an RMS symmetrical interrupt and bracing rating the same as the bus to which they are connected. Motor starter units in the control centers shall be the combination fusible disconnect switch and magnetic contactor type. A hand reset button for the thermal overloads shall be provided in the unit door. Motor starters shall be sized as shown on the Drawings except that no smaller than NEMA size 1 starter shall be employed in any unit. All thermal overloads shall be the ambient compensating type.

Identification plates shall be furnished for each motor control center and each respective device from laminated phenolic, with white letters engraved on a black background, mounted with self-tapping screws. Wording shall be as shown on the Drawings.

Indicating lights, pushbuttons and selector switches mounted with motor starter units shall be on a plate in the unit itself and withdrawn from the unit without the removal of any wiring. Quick release door mounted hardware will also be acceptable.

Pilot lights, pushbuttons, etc., shall be labeled as indicated on the Drawings. Starter units shall be equipped with pushbuttons, selector switches, etc., as shown on the Drawings. Individual pushbutton, pilot light and selector switch nameplates shall be a standard metal engraved plate. Control and pilot devices shall be the oiltight type, rated at 10A, 600V a-c.

Relays shall be provided for operation of auxiliary equipment where required by the Drawings, and shall be 10A, 600V rated machine tool type with at least 1 N.O. spare contact.

Timers shall be synchronous type, knob adjustable withnumbered scale, except where otherwise shown on the Drawing.

The Contractor shall be responsible for providing additional space for aux. pilot devices in blank cubicles adjacent to the starters when shown on schematics.

Wiring terminals shall be plainly and durably marked. Terminal blocks should be numbered in numerical ascending order, starting from top to bottom and from left to right. A unique number shall be used to identify wires. The unique number shall be used once in a complete wiring system. All wires shall be identified at each termination by a tag. Wires shall be color coded as follows:

1. Line and load circuits - black.
2. Control Circuits - red.
3. Equipment grounding conductors - green.
4. Current carrying grounded conductor - white.
5. Additional colors may be used to facilitate identification between control panel and devices on the industrial equipment except that black shall be used for all wiring at line voltage.

All control wiring shall be SIS, 90°C, Class C stranding or THHN/THWN approved as 90° C MTW. Wire shall be 19 strand No. 14 AWG minimum.

NOTE: Deviations from this scheme may be made only on internal wiring of individual devices purchased completely wired or where insulation is used that is not commercially available in the colors required.

Each motor starter unit shall have an individually fused control power transformer. Control transformers shall be sized to handle the inrush current and the continuous current of the circuit without overheading and with less than 5% voltage drop under any load condition. Provide minimum of 100 VA excess capacity over the requirements. Minimum transformer size shall be 100 VA. The control power transformers shall all be connected to alternate line conductors (e.g. L1, L2 - L2, L3 - L3 L1).

The Contractor shall coordinate switch, fuse, starter and thermal overload sizes with final load values.

Suggested Manufacturers. The equipment shall be the product of one of the following manufacturers, or equal:

Allen Bradley	General Electric
Allis Chalmers	I.T.E.
Cutler Hammer	Square 'D' Co.
Furnas Elec. Co.	Westinghouse

MOLDED CASE CIRCUIT BREAKERS

Where molded case circuit breakers are required they shall be dual element thermal-magnetic protective devices assembled into a enclosing housing of insulating, inorganic material. The frame size and trip rating shall be as shown on the Drawings. Unless otherwise noted they shall be 3 pole devices. All breakers shall be ambient compensated for enclosure mounting.

Molded case circuit breakers shall operate both manually for normal switching functions and automatically to open when overcurrent conditions exist. All poles of a multipole breaker shall open and close simultaneously. Unless otherwise noted, the breakers shall have a nonadjustable instantaneous magnetic element and a long time thermal element. The thermal element shall have an inverse time-current characteristic. The breakers shall have an overcenter type, quick-make, quick break mechanism. When the breaker has automatically tripped the handle shall assume a center tripped position. Frame sizes and interrupting capacity shall be as follows:

Distribution Breakers.

Frame Size In Amperes	Interrupting Rating (Symmetrical Amperes)	
	240 V	480V
100	18000	14000
225	25000	22000
400	42000	30000
1000	42000	30000
1600	65000	50000
2000	65000	50000

High Interrupting Capacity Molded Case Circuit Breakers.

Frame Size In Amperes	Interrupting Rating (Symmetrical Amperes)	
	240V	480V
100	65000	25000
225	65000	35000
400	65000	35000
1000	65000	30000

Suggested Manufacturers. The equipment shall be the product of one of the following manufacturers, or equal:

General Electric	Allen Bradley
I.T.E.	Cuttler Hammer
Square 'D' Co.	Westinghouse

SWITCHES

Where general use switches are required they shall be load-break, heavy duty, quick-make, quick-break switches. Switches shall be gang operated by an insulated steel cross-bar. Switch I^2t rating shall be equal or greater than the fuse let through with which it is used when fusible. Where the switch is unfused the I^2t rating shall be equal to or exceed that I^2t let-through of the nearest upstream protective device in its circuit.

Fusible Switches. Fusible switches shall be positive pressure fuse clips. Fuse clips shall be suitable for use with the class of fuses required and sized to equal the switch continuous current and I^2t rating. Fusible switches shall be rated for 100,000 amp RMS symmetrical short circuit current. Where Class K-5 or "L" fuses are used with NEC clips, a label shall be applied at the fuse clips stating the class and size of fuse used.

Disconnect Switch. Service entrance disconnect switches shall be approved for service entrance switching applications.

Where a motor disconnect switch is required they shall be horsepower rated through 100 Hp. Above 100 Hp all switches to be clearly marked - "DO NOT OPEN UNDER LOAD."

Switch Enclosures. When enclosures are required they shall be heavy formed steel with interlocked cover so that the switch may not be closed with the cover open or the cover opened with the switch closed. A defeat mechanism shall be provided to operate when the enclosure is open to bypass the interlock. External operating handle shall be lockable in the open and closed position.

Suggested Manufacturers. The equipment shall be the product of one of the following manufacturers, or equal:

Allen Bradley	I.T.E.
Crouse Hinds	Square 'D' Co.
Cutler Hammer	Westinghouse
General Electric	

LOW VOLTAGE FUSES

Low voltage fuses shall be Class K-5 or "L" and sized as shown on the Drawings or as specified herein. The Contractor shall obtain stick-on labels from the manufacturer and apply the same to fusible equipment recording the fuse type and ampere rating. He shall also compile a list of all fuse type and sizes for the various fusible equipments and submit three neatly typewritten copies of the same to the Engineer. At the completion of the project he shall check all equipment fuses to verify that all are of proper size and are in opering condition. He shall replace any and all fuses not meeting these requirements.

Low Voltage Fuses for Motor Protection. Low voltage fuses used for motor circuit protection shall be Class K-5 dual-element current limiting high interrupting capacity. They shall be Underwriters' Laboratories listed 200,000 ampere RMS symmetrical minimum interrupting capacity at rated voltage. The maximum clearing I^2t let through and maximum let-through currents shall be as listed in the following table.

Fuse Size	$I^2t \times 10^3$	I Let Through
0-30	50	5,500
31-60	125	9,000
61-100	340	15,000
101-200	1,350	30,000
201-400	5,000	55,000
401-600	10,000	75,000

For largest fuse in each fuse size the melting I^2t shall be greater than the total clearing I^2t of the largest fuse in the next smaller size. The continuous current carrying capacity shall not vary more than 10% when the fuse is operated in fuse ambients ranging from 20° - 50^oC.

Fuses shall be sized at the maximum allowed by the NEC for the motor full load current. The actual nameplate rating of the motor shall be used in all cases.

Low Voltage Fuses For Feeder Circuit Protection. Low voltage fuses used for feeder circuit protection shall be Underwriters' Laboratories listed as Class K-5 or "L" and shall have 200,000 ampere RMS symmetrical minimum interrupting capacity at rated voltage. They shall be current limiting with no intentional time delay. Sizes shall be as shown on the Drawings or modified as determined by the coordination study.

Suggested Manufacturers. The equipment shall be the product of one of the following manufacturers, or equal:

Bussman
Economy
Shawmut

A-c COMBINATION MOTOR STARTERS

Where a-c combination motor starters are required they shall be a-c magnetic motor starter as specified hereinabove, in conjunction with either of two types of protective devices: a fusible, general use switch or a molded case circuit breaker as specified herein.

A-c MAGNETIC MOTOR STARTER

Where a-c magnetic motor starters are required they shall be one or more a-c contactors in combination with overload protection. NEMA size 1 shall be the minimum starter size unless otherwise shown. The overload protection shall consist of three (1 per phase) elements for three phase systems or one element for single phase system. The elements shall be the ambient thermal compensated type thermal overloads unless otherwise shown. They shall be sized in accordance with Article 430 of the NEC as a maximum and the following as a minimum:

Motors with a service factor not less than 1.15	=	115%
Motors with a marked temperature rise not over 40^oC	=	115%
All other motors	=	105%

The motor nameplate, full load current shall be used in all cases. The Contractor shall provide a compiled list of motors, fuse sizes, all overload sizes and types for their respective motors and submit as part of this contract:

The three phase starter may be the following types:

Full voltage non-reversing (FVNR) - a 3 pole magnetic contactor with a set of three overload devices.

Full voltage reversing (FVR) - two 3-pole magnetic contactors with a common set of three overload devices.

Two-speed (for two winding motor) - two 3-pole magnetic contactors, each with its own set of three overload devices.

Two-speed (for single winding motor) - two magnetic contactors, a 5-pole for high speed and a 3-pole for low speed, each with its own set of three overload devices.

Reduced voltage (for wye connected part winding

motors) - two 3-pole magnetic contactors, each with its own set of three overload devices and a timer for closing of the running contactor. The running contactor shall be sized for the motor full load current and the starting (half winding) contactor shall be sized for at least 75% of the full load current and shall be capable of interrupting at least 10 times full load current.

Reduced voltage (closed transition autotransformer type) - three magnetic contactors, two 2-pole and one 3-pole with a common set of three overloads, a timing relay and an autotransformer with taps at 50%, 65%, 80% and 100% and an integral temperature switch or timing relay to protect the transformer windings.

The Contractor is to provide overload protection for all motors, whether single or polyphase, not having integral motor protection.

A-C CONTACTORS

Where a-c contactors are required they shall be standard magnetically operated contactors. They shall have 120V, a-c coils for NEMA sizes 3 and below, and 120V a-c or d-c coils for NEMA sizes 4 and above. A-c operated contactors shall have straight line design of the coil-armature-contacts action. D-c operated contactors shall have clapper action.

MANUAL STARTERS

Where manual motor starters or switches are required, they shall be furnished and installed with thermal overloads where shown on the Drawings.

Suggested Manufacturers. The equipment shall be the product of one of the following manufacturers, or equal:

Allen Bradley	Allis Chalmers
Clark Controller Co.	Cutler Hammer
General Electric	I.T.E.
Square 'D' Co.	Westinghouse

LOW VOLTAGE POWER FACTOR CAPACITORS

Power factor correction capacitors shall be furnished as indicated on the Drawings and shall be rated for the same voltage as the associated motor.

Capacitors shall be industrial grade and not "motor run". Type, 3 phase, 60 Hz with synthetic liquid impregnant, discharge resistors and internal fuses. Units shall be in dust-proof enclosures with screw held covers suitable for floor or wall mounting, except where otherwise shown on the Drawings.

Installation. Mount the capacitors at the motor or on an adjacent wall. Allow space for power line openings, especially for high voltage units and for lifting cables. Wire connections from the capacitor enclosure shall be made with lock-nutted, end bushed nipples. Capacitors may be combined into single enclosures where motors are grouped.

Wires to capacitors shall have ampacity at least 1.35 times the capacitor rating and be fused if more than 25 ft. long. The motor junction box shall be the point of termination for the capacitor wires.

The capacitor shall be designed and installed per NEMA standards.

Suggested Manufacturers. The equipment shall be the product of one of the following manufacturers, or equal:

Cornell Dubilier	Westinghouse
General Electric	Myron Zucker
Sprague	Versatex

CONTROL AND PILOT DEVICES

All control and pilot devices furnished by the Contractor for field mounting shall be 600V, 10 amp rated, oil tight type and shall be housed in NEMA type enclosures as specified in the General part of the Low Voltage Equipment Specification. Contractor furnished panel mounted control and pilot devices shall be 600V, 10 amp rated oiltight construction where mounted on the face of the panel. Descriptive nameplates shall be provided for each control and pilot device furnished whether field mounted or panel mounted. Nameplates shall be metal or engraved phenolic.

Start pushbuttons shall be 600V rated oiltight construction with extended guard and black color insert, stop pushbuttons shall be 600V rated oiltight with half-guard and red color insert. Pilot lights shall be 600V rated oiltight push-to-test 120/6V transformer type with color caps as required.

All single conductor control wiring shall be red 14 AWG with wire markers at each termination point. Wire numbers shall conform to wiring designations shown on the control schematics. All wiring terminating at terminal blocks shall have wire markers. Terminal blocks shall be 600V rated channel mounted box lug or binding head screw type with white marking strip. Terminal blocks shall be numbered in numerical ascending order from one to x from top to bottom.

All internal subplate panel mounted control and pilot devices such as timers, relays, etc., shall be 600 V, 10 amp rated machine tool construction with coil voltage as required and convertible contacts. One spare N.O. contact shall be provided on each device or parallel devices.

Timers shall be synchronous type, knob adjustable with numbered scale, except where otherwise shown on the Drawing.

Control transformers shall be 120V, single phase secondary sized to handle inrush currents and to accommodate the continuous load of the circuit with less than 5% voltage drop plus 25% spare capacity. Minimum size shall be 100 V.A.

All field mounted control and pilot devices subject to vibration or needing movement to adjust shall be connected with 18-inch minimum length of liquid tight flexible conduit.

All miscellaneous mounting hardware required for the proper installation of this equipment shall be provided by the Contractor.

Suggested Manufacturers. The equipment shall be the product of one of the following manufacturers, or equal:

RELAYS & TIMERS
- Allen Bradley
- General Electric
- Cutler Hammer
- Eagle Signal
- Square 'D' Co.

WIRE MARKERS
- Alpha Wire Corp.
- Brady Co.
- Ideal Indust.

PUSH BUTTONS, PILOT LIGHTS, SEL. SWITCHES
- Allen Bradley
- Cutler Hammer
- General Electric
- Square 'D' Co.
- Micro-Switch

LIMIT, PRESSURE, FLOAT SWITCHES
- Allen Bradley
- Barksdale
- Consolidated Electric
- General Electric
- Magnetrol
- Mercoid
- Square 'D' Co.
- United Electric Controls

CONTROL PANELS

Control panels furnished by the contractor under this item of work shall be NEMA-12 construction unless stated otherwise and shall be fabricated as follows:

1. Panels shall be fabricated from sheet steel welded and bolted into a rigid self--supporting structure a maximum of 90-inches high (including floor stand) and a minimum of 8-inches deep. Overall length shall be coordinated with space requirements as indicated by the Drawings.

2. Panel bodies shall be 12 gauge steel for panels up to 42 inches in width, and 10 gauge minimum for panels exceeding 42 inches in width. Panel subplates shall be 12 gauge steel for panels 42 inches in width or less, and 10 gauge minimum for panels exceeding 42 inches in width. Stiffening members shall be provided for strength and stiffness as required.

3. A minimum of 4-inches shall be provided between the edge of the panel subplate and the outside walls of the panel body to insure adequate wireway space for external wires entering the panel. The panel subplate shall be mounted on collar studs for easy removal. Print pockets shall be provided on each door. Tapped brackets welded to the inside top of the panel, complete with fluorescent strip lights interlocked with the master door, shall be provided on all panels exceeding 48 inches in width.

4. Lugs for surface mounting shall be provided on single door panels, and 8-inch high floor stands and removable lifting eyes shall be provided on multi-door panels. Panel surfaces shall be phosphatized prior to painting and then painted with grey primer outside and baked white enamel inside.

5. Panel doors shall have a continuous piano hinge for ease of removal, and shall be sealed with an 1/8-inch thick minimum cellular neoprene gasket cemented with oil-resistant adhesive and held in place with a retaining strip. Two door enclosures shall have a removable center post fabricated from 10 gauge steel. Single door panels less than 40 inches high shall be equipped with a two-point door latching mechanism. Panels 40-inches high or more shall be equipped with a three point latching mechanism. Multi-door panels shall be equipped with latching mechanisms as described above plus a mechanical interlock to prevent the opening of any door unless the master door is open. (Doors may be closed in any sequence)

6. Panels shall be equipped with a flange mounted disconnect switch or circuit breaker mechanically interlocked with the door(s), complete with defeat mechanism.

7. All relays, timers, latch relays, etc. installed on the panel subplate, shall be provided with a minimum spacing between the component and the wire duct of 1½-inches above and one inch below. Minimum spacing between adjacent components shall be ¼-inch.

8. A minimum of 2 inches shall be provided between terminal strips and wireways or terminal strips and terminal strips. In general, terminal strips shall be mounted on the left vertical edge of the subplate. Additional terminal strips, if required, may be mounted on a 30 degree angle bracket at the bottom of the subplate. Where terminal strips are mounted side-by-side, the terminals shall be elevated 1½-inches above the subplate to allow wires to pass underneath.

9. Subplates shall have a minimum of 15% spare mounting space, and terminal strips shall have a minimum of 25% spare terminal blocks.

10. Panel wireways shall be provided between each row of components, and adjacent to each terminal strip. Wireways shall be a minimum of 1-inch wide and 3-inches deep with removable snap-on covers and perforated walls for easy wire entrance. Wireways shall be constructed of non-metallic materials with a voltage insulation in excess of the maximum voltage carried therein.

11. Internal panel wiring shall be 19 stranded No. 14 AWG, 90°C, MTW, Class C stranded or THHN/THWN approved as 90°C MTW. All panel wiring not run in wireways shall be bundled and tied. Wiremarkers shall be provided at each wire termination point.

12. All wires to internal components shall be connected to the "inside" of the terminal strip. All wires to external components shall be connected to the "outside" of the terminal strip. Wires to enclosure door mounted components shall be considered as internal wires. No more than two wires shall be connected to any one control terminal point.

13. Door mounted equipment shall consist of pilotlights, pushbuttons, selector switches, meters, indicating timers, etc. Spacing between horizontal rows of components shall be 1-7/8-inches minimum. Spacing between vertical columns of components shall be 1½-inches minimum. Components shall be grouped and/or located as indicated on the Drawings. The distance from the bottom row of components to the floor shall be not less than 36-inches. In general, all indicating lights, pushbuttons, etc. shall be mounted in accordance with the sequence of operation from left to right and top to bottom.

14. Identification plates shall be laminated phenolic, with white letters engraved on a black background, mounted with self-tapping screws or double back adhesive foam tape. All components on the subpanel shall have identification plates mounted below the respective device.

15. Door mounted pilotlights, pushbuttons, etc., shall be furnished with matching nameplates. All identification plates shall be inscribed as indicated on the Drawings.

16. Conduit entering instrument panels shall be isolated from the panel. A separate ground wire shall be run from the ground bus of the distribution equipment providing power to the panel and connected to the enclosure "Ground Bus".

    Another ground wire shall be run into each panel from the ground mat.The wire shall be insulated RHW and connected to an isolated instrument common bus within the enclosure.

Sugested Manufacturers. The equipment shall be the product of one of the following manufacturers, or equal:

AMFCO	Keystone
Boss	Hope
Hoffman	

WIRE AND CABLE MATERIALS

The Drawings will show the number and size, and may show the construction, material and insulation of wire and cable used in circuits between equipment items.

Wire and cable sizes will be given in AWG unless specifically shown otherwise. The wire and cable shall conform to ASTM standards for concentric stranding, Class B.

The construction of wire and cable shall be single conductor (1/c) unless multiconductor cable is shown by notation in the form (x/c) where x shall be the number of separate, insulated conductors per cable. The material used in wire and cable shall be soft drawn copper unless other materials are shown on the Drawings.

Cable shall be delivered to the job site on non-returnable reels or in boxes and installed directly therefrom. The containers shall be marked to identify the size, number of conductors, types of insulation, length, insulation thickness, name of manufacturer and date of manufacture of the wire and cable. Wire and cable over one year old shall not be used.

Samples and a manufacturer's description of all wire and cable types used shall be submitted to the Engineer for his approval prior to installation.

Low Voltage Wire and Cable. 600 volt insulated copper conductor wire shall be used unless otherwise shown. Insulation shall conform to NEC requirements and be one of the following types as indicated on the Drawings or specified herein below that is OSHA and U.L. approved.

RHW-USE (Cross linked polyethylene or ethylene propylene with neoprene or hypalon jacket)

MTW (Machine tool wire)
THWN (Thermoplastic)
THHN (Thermoplastic

Low Voltage Power Wire. RHW-USE insulated, No. 12 minimum size, single conductor wire shall be used for all power conductors on 600 volt and under for three phase systems. RHW-USE insulated, No. 12 minimum size single conductor wire shall be used for all power conductors on systems with 120 volts to ground. RHW-USE wire shall be used for all underground runs.

Suggested Manufacturers. The equipment shall be the product of one of the following manufacturers, or equal:

Anaconda
General Cable
Rome
General Electric
Phelps - Dodge

Low Voltage Control Wire. THWN THHN insulated No. 14 minimum size, single conductor stranded wire shall be used for all control conductors unless multiconductor control cables or communication cables are shown on the Drawings.

Suggested Manufacturers. The equipment shall be the product of one of the following manufacturers, or equal:

Brand-Rex	General Electric
Cerro (Rockbestos)	Okonite
Femco	PWC

Instrument Cable. Instrument cable shall be 300 volt minimum insulated shielded cable consisting of 2 or more twisted conductors. Insulation on outer jacket may be PVC, Nylon or polyethylene. Conductors shall be 18 or 16 AWG Standard copper. Foil sheidling shall be employed between the conductors and the outer jacket.

Suggested Manufacturers. The equipment shall be the product of one of the following manufacturers, or equal:

Anaconda
Alpha
Belden
Dekoron

TERMINATION AND SPLICING OF LOW VOLTAGE POWER WIRE AND CABLE

Termination and splicing of wire and cable shall be done in such a manner as to maintain the insulation level, current carrying capacity and mechanical strength of the wire and cable.

Where splicing of 600 volt conductors is required it shall be done in junction boxes only. In general, when splicing wire and cable, pressure type connectors shall be used. For conductor No. 6 AWG or smaller twist-on, insulated, pressure type connectors or hollow metal caps of the same material as the conductors, crimped and taped shall be used. Wire nuts or other twist-on connectors not

Underwriters' Laboratories listed as pressure type connectors shall not be used. For conductors larger than No. 6, AWG compression type or bolted type splicing connectors shall be used for mechanical connection. They shall be 600 volt insulated in accordance with the latest recommendations for the type and size of the cable being spliced.

Termination of power conductors to equipment terminals or terminal blocks shall be made with pressure type conenctors which are specifically designed for the type of terminations to be made. For conductors No. 6 AWG or smaller, no more than two wires shall be terminated in the same pressure type connector and the two wires shall be no more than four wire gauge sizes apart. For conductors larger than No. 6 AWG no more than one conductor shall be terminated within the same pressure type connector. When one or more taps are required from a main power conductor mounted in an enclosure a bus-bar shall be furnished with individual pressure type connectors. The number and size of wires per each pressure type connector shall be limited as noted above.

TERMINATION AND SPLICING OF LOW VOLTAGE CONTROL WIRE AND CABLE

Termination and splicing of control wire shall be done in such a manner as to maintain the insulation level and current carrying capacity of the wire.

Where splicing of control wire is required it shall be done with insulated twist-on connectors, pressure type connectors or insulated hollow metal caps of the same material as the conductors, crimped and taped. Wire nuts or other twist-on connectors not Underwriters' Laboratories listed as pressure type connectors shall not be used. Splicing of multiconductor cables will not be accepted.

Termination of control wires to equipment terminals and termination of multiconductor cables to terminal blocks or equipment terminals shall be made with closed-end insulated lug or without lugs using pressure plate type terminal blocks. No more than two insulated lugs shall be connected to any one terminal and no more than two wires shall be connected to any one pressure plate type terminal.

LIGHTING TRANSFORMERS
Lighting transformers shall be rated for either 480 to 120/208Y volts, three phase, 60 Hertz or 480 to 120/240 volts, single phase, 60 Hertz as indicated on the Drawings. They shall have kVA rating as indicated on the Drawings for 115 degrees C rise over 40 degrees C ambient temperature. All units shall be UL listed type HF.

Adequate ventilation shall be provided. Taps, two each 2½ percent above and below rated voltage shall be provided. The ambient in the terminal or wiring compartment shall permit the use of 75 degree C cable. Transformers shall be in accordance with the latest editions of the applicable IEEE and NEMA standards.

All transformers shall have the case and secondary neutral grounded by wire to the ground bus of its primary distribution equipment. Conduit grounding only is not acceptable.

LIGHTING PANEL BOARDS
The Contractor shall furnish and install circuit breaker lighting panelboards with an identification plate and circuit designation list as shown on the Drawings and located on the inside of the panelboard. Panelboards shall be dead front safety type equipped with lockable molded case lighting circuit breakers of frame and trip rating as shown on the Drawings. Panelboards shall be rated either 120/240 volt, single phase, 3 wire, 60 Hertz, or 120/208 volt, three phase, 4 wire, 60 Hertz, as indicated on the Drawings. Panelboards and breakers shall be braced for 10,000 RMS symetrical amperes fault current minimum or as shown on the Drawings. On each lighting panelboard, spares shall be provided according to the following Schedule:

Assignments	Min. Spares	Panel Size
up to 8	4	Panel size to include
9-12	4	assignments and
13-15	4	minimum spares as
16-23	6	noted.
24-34	8	

Spare circuit breakers shall be single pole 20A units unless otherwise shown.

All wiring for 120/208V or 120/240V panelboard circuits shall be 3 No. 12 wires minimum. Wires shall be sized in accordance with the breaker size for each circuit assignment, except where otherwise shown on the Drawings. The ground wire shall be securely fastened at both ends.

Provide padlocking accessories for all breakers marked "L" on the Drawings. Install the breaker panel with two spare sets of padlocking accessories inside for future use.

MOLDED CASE CIRCUIT BREAKERS
Where molded case circuit breakers are required, they shall be dual element thermal-magnetic protective devices assembled into an enclosing housing of insulating inorganic material. The frame size and trip rating shall be shown on the Drawings. Unless otherwise noted they shall be 3 pole devices. All breakers shall be ambient compensated for enclosure mounting.

Molded case circuit breakers shall operate both manually for normal switching functions and automatically to open when overcurrent conditions exist. All poles of a multipole breaker shall open and close simultaneously. Unless otherwise noted, the breakers shall have a nonadjustable instantaneous magnetic element and a long time thermal element. The thermal element shall have an inverse time-current characteristic. The breakers shall have an overcenter type, quick-make, quick-break mechanism. When the breaker has automatically tripped the handle shall assume a center tripped position. Frame sizes and interrupting capacity shall be as follows:

Lighting Breakers. Lighting breakers for 15-100 amp service shall have 10,000 Ampere Interrupting Rating.

Suggested Manufacturers. The low voltage molded case circuit breakers shall be the product of one of the following manufacturers, or equal

Crouse Hinds	I.T.E.
General Electric	Square 'D' Co.
Cutler-Hammer	Westinghouse

SWITCHES AND RECEPTACLES
Wall switches and receptacles in concealed conduit runs shall be set in cast iron boxes and so adjusted that the face plate shall be flush with the wall finish. Wall switches in exposed conduit runs shall be set in surface mounted cast iron boxes with cast, neoprene gasketed covers. When more than one switch occurs in the same location the switches shall be set in gangs with common face plate. Wall plates above grade shall be chrome plated brass. Those below grade shall be cast. Water tight or NEMA 4 shall imply screw cap cast cover plates for receptacles and plunger type operators for switches.

SWITCHES
Switches shall be rated for 20 amperes at 120-277 volts a-c. Switches shall be either SPST, SPDT (3 way), or DPDT (4 way), as indicated on the Drawings. They shall be mounted at a height of 4 feet above the floor unless otherwise indicated. Switches in hazardous locations shall be approved for the Class and Group of the location.

RECEPTACLES

Receptacles shall be of the specification grade or heavy duty grade grounding type. The receptacles shall be rated as called out in the wiring device schedule shown on the Drawings. The receptacles shall be capable of accepting parallel pin and tee slot plugs. Receptacles shall be mounted at a height of 18 inches above the floor unless otherwise indicated. Receptacles shall be of the proper NEMA type for the voltage of utilization and shall conform to that shown on the Drawings.

Suggested Manufacturers. The switches and receptacles shall be the product of one of the following manufacturers, or equal:

Arrow Hart	Hubbell
Bryant	Pass & Seymour
General Electric	Russell & Stoll

LIGHTING FIXTURES

Lighting equipment shall be furnished as shown on the Drawings. Fixtures shall be as listed in the "Fixture Schedule" on the Drawings. Fixtures shall be installed in locations shown on the Drawings subject to slight alterations which may be found advisable after construction has commenced. They shall be arranged carefully both as to line and level to present a good appearance. All fixtures shall be furnished complete with new lamps at the time of acceptance.

WIRE AND CABLE TESTING

When wire and cable installation is complete and not more than 72 hours before energization of the system the wire and cable shall be tested.

Testing shall consist of a megohmeter test for all insulated wire and cable followed by and appropriate d-c high potential test and an additional megohmeter test of the high voltage insulated wire and cable. A certified copy of all test results shall be submitted to the Engineer prior to energization of the system. Test results shall include a plot of leakage current versus time and versus test voltage for the d-c high potential tests.

High voltage cables shall be given a Megger test with a 2500 volt motor driven megger. Test shall be held for at least 5 minutes. Readings shall be taken every 30 seconds during the first 2 minutes and then one minute apart until three equal consecutive readings are obtained. All tests shall be made after all splices and terminations are completed, but before connection to equipment. If cable is terminated at potheads, test voltage shall not exceed their test rating. D-C high potential tests shall be as recommended by the cable manufacturer for the insulation rating of the cable and as approved by the Engineer.

600 Volt rated power cable shall be given a megger test with a 1000 volt megger and held for one minute or until reading reaches a constant value for 15 seconds. Minimum acceptable reading is 100 megohms. Cable shall be unconnected when tested. Control cables shall be tested with the 500 volt megger. Minimum acceptable reading is 1.0 megohm.

Ambient temperature and humidity during test shall be recorded.

All wiring to be checked for continuity and proper phase sequence.

All wiring connections must pass a visual inspection for workmanship and conformance with standard practice.

GROUND SYSTEM TESTING

After the grounding mat is completed the Contractor shall test the resistance of the mat in the presence of the Owner's representative. The measured resistance shall not exceed 5 ohms.

The measurement shall be done with a ground ohmer or the IEEE Standard No. 550 paragraph 3.42 method. Testing shall be performed during normal dry weather conditions with at least five non-rain days elapsing prior to test.

All ground paths shall be tested for continuity, and all connection points inspected.

Continuity shall be checked by applying a low d-c voltage source of current, capable of furnishing up to 100 amps, between all electrical equipment grounds and the ground grid. The grounding path must conduct a 100 amps at a resistance of 0.010 ohms or less as calculated from the current and voltage.

MOTOR TESTING

All motor insulation shall be tested by using a 500V d-c (Min.) megger and applying test until a constant reading of the following is obtained:

$$R_{min.} = 4\ (KV + 1)\ @\ 25^{o}C \text{ winding temp.}$$

$$R_{min.} = KV + 1\ @\ 40^{o}C \text{ winding temp.}$$

If any motors do not meet requirements of the megger test, blow hot air through motors to dry out and repeat until test is passed. If desirable, drying can be done by applying an electrical potential to the equipment. However, in no case, induced or direct, shall the voltage or current exceed the continuous rating of equipment being dried.

After passing the megger test, all motors shall be hi-pot tested, @ 200% rated voltage for a minimum of one minute.

EQUIPMENT TESTING

In general, all electrical equipment shall be tested in any or all of the following ways as applicable. All tests which are applicable for a particular item of equipment under test shall be performed.

a. Megger all bus work phase-to-phase and phase-to-ground. The minimum acceptable steady-state value is 100 megohms.
b. Megger all power circuit breakers and circuits supplied phase-to-phase and phase-to-grpund (100 megohms minimum).
c. Test all current transformer circuits by applying current to the secondary wiring at the ct terminals until the contactor trips.
d. Test time and set protective relays. All relays shall be timed at various times (minimum of three points) the pick-up value of the operating quantity to determine agreement with published curves and adjust as necessary to agree with the coordination study required settings. The exact tests to be performed vary with the type of relay. Manufacturers instructions for the relay shall be complied with.
e. After all electrical work has been completed, demonstrate to the Owner's representative that the entire electrical installation is in proper working order and will perform the functions for which it was designed by functional testing.
f. Make any specific tests required by the manufacturer's installation instructions.

CHECK-OUT PROCEDURES

In general, all check-out procedures (as listed below) which are applicable for a particular item of equipment shall be performed.

a. Vacuum the interior of all cubicles and remove all foreign material.
b. Wipe clean with a lint-free cloth all insulators, bushings, bus supports, etc.
c. Check all primary and secondary fuses with an ohmmeter.
d. Check and adjust all time delay, under voltage devices, phase relay, over current relays, etc. as directed by the Engineer.
e. Fill all motor bearings requiring oil.
f. Check and adjust thermal overload heater elements to correspond with motor full load current and service.
g. Check direction of rotation of all motors and reverse connections if necessary. Check rotation with motor mechanically uncoupled where reverse rotation could damage equipment.
h. Ring out all wiring to ensure its correctness.
i. Check all exposed bolted power connections.
j. Check operation of all breakers, contactors, etc. and all control and safety interlocks.
k. Check tightness of all bolted structural connections.
l. Check leveling and alignment of all enclosures.
m. Check operating parts and linkages for lubrication, freedom from binding, vibration, etc.
n. Check for chipped bushings, cracked porcelain or other physical damage to enclosures.
o. Check all contactor contact alignments with the stationary parts in the enclosures.
p. Check to make sure all pt's, ct's lightning arresters, surge capacitors, etc. are connected to ground.
q. Check tightness and correctness of all control connections at terminal blocks, relays, meters, switches, etc.
r. Clean all auxiliary contacts and exposed relay contacts after vacuuming.
s. When a coordination study is part of this contract, all adjustments and settings shall conform to the results of the study.

14. INSTRUMENTATION

GENERAL

SCOPE OF WORK UNDER THIS SECTION

This work shall be subject to the conditions of the General Requirements and include the furnishing of labor, materials, tools, equipment, accessories and services necessary for providing and installing the items as shown on the Contract Drawings and/or as herein required.

Equipment furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with detail Drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer as approved by the Engineer. Special attention shall be given to the general equipment stipulations of the General Requirements.

DRAWINGS

The Drawings are not intended to show every detail of construction or arbitrary location of piping, duct work, or equipment. Where building construction makes it necessary or advisable to change location of piping, air ducts, or equipment, the Contractor shall so inform the Engineer for his approval and permission.

The Contractor shall give to all trades the exact locations and sizes of all openings required for piping, air ducts, and equipment plus information as to all spares required.

WORK INCLUDED

The work shall consist of furnishing a complete and operable instrumentation system conforming to the Drawings and these Specifications including Functional Descriptions as may be contained herein.

WORK NOT INCLUDED

The following is a list of related work that will be done under other sections of the work:

Section	8	- Piping 4-inches and larger
Section	12	- Plumbing, Process Piping et. al.
Section	13	- Electrical
Misc.		Equipment Sections

Components shall be installed in accordance with the Standard Details for Instrumentation. Installation shall be done where shown and as indicated on the Drawings.

Those elements that are supported by plumbing or piping, or those elements that have only plumbing or piping connections shall be installed under those Sections. Plumbing, piping or pneumatic signal connections to all elements requiring such connections shall be made under those Sections. Control panels will be installed under Electrical, with all piping connections to control panels being made under Plumbing.

All elements shall be installed under Electrical excepting those to be installed under Pipe Work or Plumbing as specified or shown on the Drawings. Wiring connections, both power and signal, to all elements requiring such connections shall be made under Electrical.

CODES, ORDINANCES AND INDUSTRIAL STANDARDS

The design, testing, assembly, and methods of installation of the wiring materials, electrical equipment and accessories proposed under this Contract shall conform to the National Electric Code and to applicable state and local requirements. UL listing and labeling shall be adhered to under this contract.

Any equipment that does not have a UL, FM, CSA, or other approved testing laboratory label shall be furnished with a notorized letter signed by the supplier stating that the equipment furnished has been manufactured in accordance with the National Electric code and OSHA requirements.

Any additional cost resulting from any deviation from codes or local requirements shall be borne by the Contractor.

PERMITS, INSPECTIONS AND LICENSES

The Contractor shall procure all necessary permits and licenses, observe and abide by all applicable laws, regulations, ordinances, and rules of the state, territory or political subdivision thereof, wherein the work is done, or any other duly constituted public authority, and further agrees to hold the Owner harmless from liability or penalty which might be imposed by reason of an asserted violation of such laws, regulations, ordinances or other rules.

Upon completion of the work the Contractor shall secure certificates of inspection from the inspector having jurisdiction and shall submit three copies of the certificates to the Owner.

The Contractor shall pay the fees for the permits, inspections, licenses and certifications when such fees are required.

EQUIPMENT SUPPLIER

All equipment shall be furnished by a single manufacturer, shall be of the latest and most modern design and shall have overall accuracy as guaranteed by the manufacturer. The manufacturer furnishing the equipment shall be responsible for the system design, equipment panel design, installation, and the correct operation of the equipment after installation. All components shall be manufactured or furnished by one manufacturer except as noted or approved.

When called for in this section the manufacturer shall also be responsible for furnishing a maintenance service contract as part of this work for a period of one year.

The equipment shall be the product of one of the following manufacturers, or equal:

ACCO-Bristol/Datamaster
Autocon Industries, Inc.
BIF unit of General Signal
Fischer and Porter Company
Foxboro Co.
Honeywell Corporation
Taylor Instrument Co.

RESPONSIBILITY AND COORDINATION

It shall be the responsibility of the Contractor to furnish a complete and fully operable system. The Drawings and Specifications are intended to include all details of a complete equipment installation for the purposes specified. The Contractor shall be responsible for all details which may be necessary to properly install, adjust and place in operation the complete installation. Any error in Drawings or specifications which prevents proper operation of the supplied system shall be shown correct at the time of Shop Drawing submittal for approval or brought to the attention of the engineer with or prior to the submittal.

The Contractor shall be responsible for all costs incurred to correct any of the aforementioned errors brought to the Engineers attention after the first submittal date on the equipment involved. The Contractor shall assume full responsibility for additional costs which may result from unauthorized deviations from the Specifications.

SCHEDULES

The Schedules follow this specification as necessary. The Schedules do not necessarily indicate the complete component requirements of the system, it is the Contractor's responsibility to incorporate all necessary components into the system.

COMPONENT REQUIREMENTS

For the purposes of uniformity and conformance to industry standard, signal transmission modes shall be either electronic 4-20 mA d-c or pneumatic 3-15 psi only. No other signal characteristics are acceptable. 4-20 mA d-c signals shall be such that devices may be wired in parallel for 1-5 V d-c as required. The 1-5 V d-c mode shall be employed only within the control panel enclosures. All electronic devices shall be solid state.

Transmitted electronic signals to equipment of other vendors and between control panels shall be a separate isolated floating output for each item of equipment and shall conform to ISA Standard S 50.1.

Electronic. All electronic signal converters shall have an isolated floating output signal of 4-20 mA d-c which is directly proportional to input signal regardless of the form of that input signal. Enclosures shall be NEMA 1, 4 or 7 as indicated in the Schedules. Intrinsically safe systems, as approved by Factory Mutual, shall be furnished when called for. Each device shall be provided with adjustments for gain and bias. The resultant output shall be 4 to 20 mA d-c into approximately 750 ohms. Accuracy shall be ± .5% of full scale output.

Unless otherwise specified, all signal converters shall be part of a true two-wire system in which the power to operate the signal converter is supplied by the next element. No external power connections shall be allowed unless specifically called for in this specification.

Where an external power source is called for the unit shall accept 120 V ± 10% a-c power.

Electronic controllers shall receive a 4-20 mA signal for process variable or set point and be capable of providing power to operate two wire transmitters or provide power indirectly through a separately furnished power supply. External power shall be derived from 120 V a-c.

Current to current converters shall be used as power boosters to provide sufficient signal power as required. It is the manufacturer's responsibility to determine under which circumstances and locations where power boosters are required, provide them and to integrate them into the instrumentation system to make the system function properly.

Package and Scales. All instruments shall be panel mounted or enclosed for wall mounting as shown on the Drawings or in the Schedule. Charts and scales are shown in the Schedule and shall be printed as shown. Standard scales will not be accepted without the Engineers' approval if it differs from those shown in the Schedule.

The size and style of the Instrument Package is shown on the prints or in the Schedule and defined in the specifications. Pneumatic panel mounted units shall match in appearance similar electronic components.

SPECIAL TOOLS, CALIBRATION EQUIPMENT AND TESTING APPARATUS

The manufacturer shall furnish any special tools, calibration equipment and testing apparatus required for the proper adjustment and maintenance of the material he provides.

The Contractor shall furnish when called for in the Schedule a solid state instrument calibrator.

Suggested Manufacturers. The solid state instruments shall be the product of one of the following manufacturers, or equal.

Transmation Inc. - Digital Potentiometer Model 1040
Foxboro Co. - Specification 200
Honeywell Corp. - Model 38372-4010-0110-000-00

MANUFACTURED MATERIALS

Shop Test. The material shall be tested where specified. Where no tests are specified, the material will be capable of meeting standard tests and the Contractor shall submit evidence, as the Engineer may require, that similarly manufactured materials have been tested and that they meet the minimum requirements of the tests. The tests shall be certified by the manufacturer and shall have been conducted in the United States of America.

Tagging. All instruments shall be equipped with a permanently attached identification tag. This tag shall be included on all field and panel mounted devices. The tags shall include the device name, serial number, Engineer's tag identification and instruction book number. In addition, those items shipped separately shall have plain markings on the shipping carton exterior showing the serial number and/or Engineer's tag identification. The tags shall be either stamped metal or engraved vinyl.

Finish. The finish on the instruments and accessories shall provide protection against corrosion by the elements in the environment in which they are to be installed. Both the interior and exterior of enclosures shall be finished.

Extra paint of each color used on the material shall be provided by the manufacturer for touch-up purposes.

Packing. Manufactured material shall be adequately packed to prevent damage during shipping, handling, storage and erection. All material shipped to the project site shall be packed in a container properly marked for identification. Blocks and padding shall be used to prevent movement.

Shipping containers for materials that must be handled with the aid of mechanical tools shall be shipped in wood-framed crates.

All materials shipped to the project site shall have at least one layer of plastic wrapping or other approved means to make it weatherproof.

Handling. The Contractor shall inspect the material prior to removing it from the carrier. If any damage is observed, he shall immediately notify the carrier so that a claim can be made. If no such notice is given, the material shall be assumed to be in undamaged condition; and any subsequent damage that occurs to the equipment shall be the responsibility of the Contractor. Repair and replacement of damaged parts will be done at no expense to the Owner.

The Contractor shall be responsible for any demurrage charges resulting from the handling of the materials.

Substitutions. References made in these specifications to specific manufacturers' products are intended to serve as a guide to type, construction and materials. Listing of a manufacturer does not imply acceptance by the Engineer of a manufacturer's particular product, productline, or latest product revision if it does not meet the specification.

The subcontractor shall, at his discretion, submit proposals in the form of shop drawings for alternative equipment that is equal to that offered by the specified manufacturers. The Engineer reserves the right to disapprove this alternative equipment if, in his opinion, it is not equal in quality, durability, appearance, strength, performance, design, physical dimensions and arrangement to the equipment offered by the specified manufacturer.

Where a Subcontractor proposes to use an item of equipment other than that specified or detailed on the drawings that is approved by the Engineer and that requires redesign of the structure, partitions, foundations, piping, wiring, or any other part of the mechanical, electrical, or architectural layout, then such redesign, new drawings, and detailing required for it shall be prepared by the Subcontractor without extra compensation.

Acceptance or rejection of the proposed substitutions shall be subject to the approval of the Engineer. Under no circumstances will the Engineer be required to prove that an item proposed for substitution is not equal to the specified item. If requested by the Engineer or Architect, the Contractor shall submit for inspection samples of both the specified and proposed substitute items.

The manufacturers listed under the "Standardization" section of this Specification shall be the only manufacturers allowed to supply the entire package.

SPARE PARTS

The manufacturer shall furnish a list of recommended spare parts for the material he provides and shall provide the recommended spare parts as part of his work. The spare parts are the property of the Owner.

The spare parts value shall be equal to 1½% of the dollar value of the Instrumentation Contract, based on the manufacturer's current published price list.

All system spare parts, as required for a period of one year, shall be included and maintained at the job site by the system supplier. These spare parts shall include as a minimum a one-years supply of expendable spare such as lamps, fuses, ink, ribbons, etc., one spare circuite board of each type furnished with the equipment except for mother boards and one spare relay of each type.

Any spares consumed during the Contract shall be replaced by the Contractor at no cost to the Owner.

SHOP DRAWINGS

Furnish, as prescribed under the General Requirements, Shop Drawings covering the items included under this section of the work.

Shop Drawings shall be submitted as a complete package for Interface Checking. All field mounted instruments shall be submitted at one time as a package and may be submitted at an early date to expedite construction. All Panel Drawings, Circuit Drawings, Schematics, and manufacturer's cut sheets with a system interconnecting diagram shall be submitted at one time, as a package for complete Interface Checking.

The information shall include Dimensional Drawings, Anchoring Details, Installation Instructions, Test Results, Wiring and Piping Diagrams. These shall be submitted in the form of Shop Drawings and manufacturer's cut sheets for switches, pushbuttons, lights, relays, timing devices, solid state timers and annunciators. The information shall include catalog descriptions, schematics and manufacturer names.

A system diagram shall show all connections required between component parts of each system and between the various sytems specified. Piping and electrical terminal blocks shall be numbered. Each line shall be identified at each termination point with the same number, and this number shall not be used again for any other purpose in the complete control scheme.

Shop Drawings submitted for approval that do not contain sufficient information for complete interface checking shall be returned by the Engineer as not approved.

The Contractor shall submit the number of copies indicated in the General Requirements and shall obtain approval from the Engineer prior to fabricating or ordering the instruments, panels, and accessories covered.

Submittals that are contrary to the design or specifications, that are approved in error do not relieve the Contractor of his responsibility for providing the specified equipment.

OPERATING AND MAINTENANCE INSTRUCTIONS

Written instructions for the operation and maintenance of the equipment furnished shall be provided. The instructions shall be short, easy to understand directions specifically written for this project describing the various possible methods of operating the equipment.

The instructions shall include procedures for tests required, adjustments to be made, and safety precautions to be taken with the equipment. These documents are to be submitted to the Engineer's office.

All at-the-plant training and instruction shall be given by the project engineer assigned to the project by the supplier or other personnel as approved by the Engineer.

SERVICE AND START-UP

The Contractor shall have an established service facility from which qualified technical service personnel and parts may be dispatched upon call. Such a service facility shall be no more than six (6) hours travel time from the job site.

The Contractor shall provide an experienced factory trained, competent, and authorized service representative of the approved supplier for a minimum of two times at the job site. Once during the installation and start-up and once after acceptance to inspect, check, adjust if necessary any part of the system.

This trip shall also be used to instruct the Owner's personnel in all aspects of operation and maintenance such as fuse locations, use of controls, instruction manuals, etc. The supplier's representative shall revist the job site for 8 hours per day as often as necessary after installation until all trouble is corrected and the equipment has passed the acceptance test and is operating satisfactorily to the Engineer.

The supplier shall furnish to the Owner, through the Engineer, a written report certifying that the equipment is operating properly, that it has been accepted by the Engineer and that the Owners' personnel have been instructed on its operation. This report will serve as the starting date for the warranty period.

ACCEPTANCE

During the course of the project, the Contractor shall prepare system test procedures for each phase of the work, approved by the Owner and the Engineer, which will demonstrate conformance of the system to the specifications and project requirements.

The manufacturer shall include in his shop drawings a general outline of the type of test he intends to perform.

The test procedure and long term test shall be performed at the manufacturer's factory prior to shipment of the equipment. The manufacturer shall notify the Owner and the Engineer at least four weeks before the expected beginning of the test in order that the test may be witnessed. In addition, the same test shall be repeated after installation to determine if damage has occurred during transit or installation, as well as providing on-site training for the Owner's personnel, or on a schedule approved by the Engineer.

System acceptance shall be identified as that point in time when (1) written oeprating and maintenance instructions have been received, (2) when the system is fully operational, (3) when it has passed the above test, and (4) is accepted by the Engineer.

CONSTRUCTION RECORDS

The Contractor shall submit prior to final payment, drawings conforming to construction records of the systems he has installed. The drawings shall include schedules showing terminal numbers at each wiring termination and piping termination. A complete system diagram shall be included.

The drawings conforming to construction records shall be prepared by the Contractor, on 22-inch x 34-inch tracing cloth, or mylar film, using the Engineer's standard symbols and notations. The tracing shall become the property of the Owner.

GUARANTEE

The Contractor shall furnish to the Owner a written one year guarantee that all equipment and parts thereof, material and/or workmanship shall be first class and free from defects and that the guarantor will, upon notice and without undue delay, without expense to the Owner, make good or repair, the whole or any part of the work which shall, within the indicated time after the date of acceptance of the completed work, fail or develop unfitness for the purpose for which it is intended, as a result of any defect in design, material or workmanship.

ULTRASONIC TRANSMITTER (LEVEL)
The ultrasonic level device shall be all solid state silicon electronics and include a mounting stand for floor or wall mounting, a sonic sensor with temperature compensation, and a control cabinet with receiver.

The sonic sensor package shall be intrinsically safe for hazardous (explosion proof) areas when called for in the Schedule. The sensor head shall be epoxy coated metal, encapsulated, or mylar for corrosion resistance.

The control cabinet shall be supplied in NEMA 1, 4 or 12 as specified in the Schedule with a full hinged front door. The controller shall contain a receiver processor and a local indicator of the output level signal on the front hinged door or behind a window in the door. All connections to the controller and sonic sensor shall be by MS or AN type connectors or on well marked terminal blocks.

The only field adjustments required shall be for zero and full scale. These shall be accomplished by a single potentiometer for each adjustment that are non-interacting to less than ± 1% of the full adjustment range. The calibration adjustment shall be accomplished with, at most, the aid of an accurate volt-ammeter. Units requiring the use of an oscilloscope are not acceptable.

Plug-in circuits or modules shall be utilized for quick replacement of malfunctioning circuits.

Operational Data:

Temperature - Sensor to operate within specifications over -10°F to 140°F. Controller to operate from 32°F to 140°F.

Pulse Rate - 1.5 pps minimum sensing rate.

Reflection Blocking - Adjustable receiver blanking to operate only on the first pulse received.

Cable Length - Sensor and controller may be separated up to 500 feet or more.

AGC - Automatic gain control to maximize signal to noise ratio.

System Accuracy - ± 1.0% of full scale over the complete temperature range.

Power Supply - 120 V a-c ± 10% at 60 Hz with power consumption of 100 watts maximum exclusive of controller heaters.

Output - 4-20 mA output linear with level into 0-700 ohms. The output shall be isolated, floating to prevent system ground loops when used with other control loops that have an established common at a remote location. Output time constant shall be adjustable from 1-10 sec.

Suggested Manufacturers. The equipment shall be the product of one of the following manufacturers, or equal:
Endress & Hauser Inc. Stevens International Inc.

FLOAT SWITCH (CORD TYPE)
Direct acting float switch shall be furnished to automatically detect liquid level change. A liquid rise of one inch from the rest position shall operate the float switch and reset will occur when the liquid level drops one inch. Mounting shall be to a one inch vertical pipe or flange for a single float application as shown in the Schedule. Free cable hanging floats with weights shall not be acceptable.

The float switch shall consist of a 316 type stainless steel housing 5½ inches in diameter, mounting clamp, a flexible three-conductor cable with a synthetic rubber jacket and a mercurcy switch. Inside the float housing will be a (normally open/closed) mercury switch potted in epoxy. The electrical load for the switch contacts will be rated 115 V a-c into a 0.5 Hp inductive load.

The three-conductor cable shall be 14 AWG with 105 strands per conductor made for heavy flexing service and underwater use. Cable length shall be as specified in the Schedule. A green grounding wire will connect internally to the float housing.

Weight and buoyancy shall be such that contaminants like a cake of grease will not result in the float switch changing operating level more than one inch. Life expectancy under normal operation conditions shall be 35 years.

Operating temperature range shall be 0° to 180°F.

It shall have a flange mounting option with eight bolts conforming to the American Standard for cast iron flanges, Class 125 (B16.1-1948) with a pressure rating in the 125 pound class.

AMMETER INDICATOR

Ammeter indicators shall be designed to accept and indicate 4-20 mA d-c signals and shall have a 25 mA d-c movement. Mid-scale of indicators shall be vertical with the pointer moving in a plane parallel to the panel face and shall indicate the units of the measured quantity. The instrument face shall be approximately 3½-inches by 3½-inches. Suitable diode protection shall be permanently attached to the instrument coil to provide protection against overcurrent. Bezel shall be black.

Suggested Manufacturers. The equipment shall be the product of one of the following manufacturers, or equal:

Weston	Westinghouse
Simpson	Triplett
General Electric	

MINIATURE INDICATOR

Current type miniature indicators shall accept a 4-20 mA d-c signal; shall be of nominal 3-inch wide by 6-inch high size; and shall have its indicating scale arranged in the vertical direction. The scale shall be in the units of the variable being measured. The unit shall have one or two inputs and pointers as indicated in the Schedules. Two trip switches shall be provided that are fully adjustable over the indicator range, when required by the control functions.

Suggested Manufacturers. The equipment shall be the product of one of the following manufacturers, or equal:

Fischer & Porter	Taylor
Acco-Bristol	Foxboro
Autocon	Honeywell

ELECTRONIC TRIP

The electronic trip alarm shall be solid state device and shall provide a contact closure output from an electronic input signal upon exceeding a preselected set-point. The trip alarm shall accept an input signal of 4-20 mA d-c. The trip point shall be adjustable over the entire input span, and shall be set by means of a knob and calibrated dial. The output shall be a DPDT relay with a 10 amp rating. The dead band shall be adjustable over 1 to 100% of span and shall be set by means of a knob and calibrated dial. The trip point and dead band adjustments shall be capable of remote mounting for front panel use when shown on the Drawings. Power requirements shall be 120 V a-c. The trip alarm shall be provided with a dust-proof enclosure and shall be suitable for panel mounting. Trip devices shall be supplied in the number as shown on the Drawings or Schedule. The manufacturer shall also determine if additional trip devices are required for the proper function of the control system with his equipment and shall provide and integrate them into the system when required. Fixed deadband units of 1% may be provided where shown in the Schedule.

Suggested Manufacturers. The equipment shall be the product of one of the following manufacturers, or equal:

Moore Industries
Rochester
Transmation

CONTROL PANELS AND CONSOLES

GENERAL

FINISH

The panel face openings for mounting equipment shall be smoothly finished cut with counterboring and trim strips provided as required to give a neat finished appearance. Graphic plates when used shall be fastened to the panel frame with fasteners not visible from the front of the graphic.

After fabrication, panel surfaces shall be given a phosphatizing treatment inside and out, and then finished with two coats of baked enamel. The panel interior shall be painted white, ANSI No. 51. The exterior color shall be selected by the Engineer.

ACCESS

Wall and or floor mounted control panels shall have a continuous piano hinge door for ease of access. Door openings shall expose a minimum of 80% of the panel interior. All door openings shall be sealed with a 1/8-inch thick minimum cellular neoprene gasket cemented with oil-resistant adhesive and held in place with a retaining strip. Print pockets shall be provided on each door. Two door enclosures shall have a removable center post. Panel doors less than 40-inches high shall be equipped with a two point latching mechanism. Panel doors 40-inches high or more shall be equipped with a three-point latching mechanism.

All components and terminals shall be accessable without removing another component except for covers. Swing out sections shall be used if mounting space is required that is not normally accessable.

Panels shall have open bottoms except where structural members are required.

ELECTRICAL

Internal panel wiring shall be 19 strand No. 14 AWG, 90° C MTW, Class C stranded or THHN/THWN approved as 90° C MTW. All panel wiring not run in wireducts shall be bundled and tied. Wire markers shall be the product of one of the following manufacturers, or equal. Brady, Westline, T&B.

Wire markers shall be provided at each wire termination point. Control wiring associated with control circuits de-energized when the main disconnect is opened shall be color coded "red". Control wiring associated with control circuits which mean "hot" when the main disconnect is opened shall be color coded "yellow". D.C. control wiring shall be color coded "blue". Ground wires shall be color coded "Green". Wire No.'s shall conform to wiring designations shown on the control schematics.

All wiring terminating at terminal blocks shall have wire markers. Terminal blocks shall be numbered in numerical order. All yellow wiring leaving the panel shall be brought to an isolated set of terminal blocks. All common terminals for instrument common shall be tagged "Instrument Common" and shall be connected by a copper ground strap to an isolated instrument common bus in the panel. The instrument common bus will be connected directly to the ground mat by a separate insulated wire. Make provisions on the common bus for this wire lug.

Provide a ground bus 0.1 x 0.5 x 6 inch minimum in the enclosure to which all instrument grounds and the panel enclosure is tied.

Under no circumstances shall the neutral side of the power source or any other terminals used for grounding power circuits be used as an instrument common. Instrument wiring shall be isolated and shielded where necessary. All wires to internal components shall be connected to the "inside" of the terminal strip. All wires to external components shall be connected to the "outside" of the terminal strip. No more than two wires shall be connected to any one terminal point.

Panel wire duct shall be provided between each row of components and adjacent to each terminal strip. Wire ducts shall be a minimum of one-inch wide and 3-inches deep with removable snap-on covers and perforated walls for easy wire entrance. Wire ducts shall be constructed of non-metallic materials with a voltage insulation in excess of the maximum voltage carried therein.

Floor standing panels and consoles shall be equipped with a flange mounted 600 V rated main circuit breaker or fusible disconnect switch with a 2 or 3 point lock. Single phase, 60 hertz power shall be supplied to the main disconnect by the Contractor. The panel fabricator shall provide any additional voltages and power requirements at the control panel to meet the requirements of the equipment contained therein. Control transformers shall be sized to handle inrush currents and to accommodate the continuous load of the circuit with less than 5% voltage drop plus 25% spare capacity. The transformer shall be 480/240 - 120V, 1 phase, 60 Hz and shall be the product of one of the following manufacturers, or equal.

Westinghouse	Square 'D'
General Electric	

All relays, timers, etc. installed on the panel subplate, shall be provided with a minimum spacing between the component and the wireduct of 1½-inches above and one-inch below. Minimum spacing between adjacent components shall be ¼-inch. Relays, timers, etc. shown in the schematics are intended to show function. Additional relays may be required in conjunction with the items shown to provide the total number of contacts required. Where limit, pressure, float switches, etc. are used, and more than SPDT contacts are indicated by the schematics, provide the additional contacts required by using auxiliary relays. All control and pilot devices such as relays, timers, etc. shall be 120 volt, 10 amp rated except where noted with coil voltage as required. One N.O. spare contact shall be provided on each relay.

Control device contacts going to unit substations and high voltage equipment for motor control shall be rated 240 V a-c/125 V d-c at 10 amps. The contacts shall handle 50 amps inrush on "make" at 120 V a-c and one amp on "break" at 125 V d-c.

A minimum of 2-inches shall be provided between terminal strips and wireducts or terminal strips and terminal strips. In general, terminal strips shall be mounted on the vertical edges of the subplate. Where terminal strips are mounted side-by-side, the terminals shall be elevated 1½-inches above the subplate to allow wires to pass underneath. Terminal blocks shall be 600 volt rated, channel mounted box lug or binding head screw type with white marking strip and shall be the product of one of the following manufacturers, or equal.

Buchanan - type 200TS or 300 TC
Square "D" - Class 9080 Type KC-1
Allen Bradley - Type 1492 - CP3
Arrow Hart - Type NT or NC

Fusible terminal blocks shall be 600 volt rated and shall be the product of one of the following manufacturers, or equal.

Buchanan - Type TS series 0300 & 300
Square "D" - Class 9080 Type KH-1
Allen Bradley - Type 1492 - CE6
Arrow Hart - Type FT

An isolated terminal block shall be installed in the main instrument panel labeled "for telephone use only" when remote alarming by telemetry is required.

Panel face mounted equipment shall consist of pilot-lights, pushbuttons, selector switches, meters, indicating timers, etc. Spacing between horizontal rows of components shall be 1½-inches center to center minimum; spacing between vertical columns of components shall be 1-7/8-inches center to center minimum. Components shall be grouped and/or located as indicated on the Drawings. The distance from the bottom row of components to the floor shall be not less than 36-inches. The top row of recording and indicating instruments shall be centered approximately 60 inches above the floor. The maximum height for annunciator windows shall be 85-inches above the floor. In general, all indicating lights, pushbuttons, etc. shall be mounted in accordance with the sequence of operation from left to right and top to bottom.

Subplates shall have a minimum of 15% spare mounting space, and terminal strips shall have a minimum of 20% spare terminal blocks.

SWITCHES, PUSHBUTTONS, LIGHTS

Selector switches shall be 120 V a-c rated oil tight construction with standard operator knob.

Start pushbuttons shall be 120 V a-c rated oil tight construction with extended guard and black color insert.

Stop pushbuttons shall have a half guard with red color insert. Contacts shall be rated NEMA B-150 and P-150.

Selector and pushbutton switches shall be the product of one of the following manufacturers, or equal.

Microswitch - Type "pw" or "pwh"
Arrow Hart - Type "OB"
Allen Bradley - Type "800 MR"

Pilot lights shall be push-to-test oil tight construction with cap colors and voltages as required. Nameplates for each switch and light shall conform to the manufacturers series and type with engraving as called for on the prints. The lights shall be the product of one of the following manufacturers, or equal.

Microswitch - Type "pwl" or "ptw"
Arrow Hart - Type "OB"
Allen Bradley - Type "800 MR"

RELAYS

Relays shall be plug-in type rated 240/120 V a-c, 10 amp with 120 V a-c coil, indicating light, and manual operator with plastic cover. Relays shall have a retainer mechanism to prevent loosening from vibration. They shall be the product of one of the following manufacturers, or equal.

General Electric - Type "CR 120"
Square "D" - Type "KP"
Potter Brumfield - Type "KUP"
Arrow Hart - Type "MTU" or "MTS"

Latching relays shall be the mechanical latching type rated 300 volt at 10 amps with continuous duty coils. They shall be the product of one of the following manufacturers, or equal.

Struther-Dunn - Type "MCL"
Square "D" - Type "8501"
Allen Bradley - Type "BXL".

For 120 volt rated latching relay contacts, they shall be the product of one of the following manufacturers, or equal.

Struther-Dunn - Type "255"
Deltrol - Type "105"

ANNUNCIATOR

The annunciator shall utilize the standard ISA-"1" sequence. Separately mounted low noise electronic audio signalling device, test and silence buttons shall be provided. Provide auxiliary contacts for all active points for remote use.

The test button shall sequence the annunciator from input to output of auxiliary contacts, testing all functions and the indicator lights in the annunciating sequence.

The electronic audio signalling device shall provide two selectable tones of 70 db at 1 foot and 90 db at 10 feet distance. Provide a 10 - 60 second time delay before audio device sounds.

All spare positions shall be prewired and active. All space positions shall be wired to accept future addition of alarm or light box modules. Light boxes and annunciators may be either relay type or solid state. The annunciators shall be the product of one of the following manufacturers, or equal:

Ronan
Riley
Beta

SHEET METAL CONSTRUCTION

Panels and consoles shall be fabricated from sheet steel welded and bolted into a rigid self-supporting structure a maximum of 90-inches high and a minimum of 20-inches deep. Overall length shall be coordinated with space requirements as indicated by the Drawings. Changes in length from that shown on the Drawings must be brought to the attention of the engineer within 90 days of contract award. Cost to modify the floor plan or wall opening will be at the equipment suppliers' expense after this 90 day period. Panel face layouts shown on the Drawings are intended to indicate the relative position of all components. Supplier shall fix exact locations and overall dimensions to meet the requirements of his own equipment.

Panel and console bodies shall be 12 gauge minimum steel for panels up to 42-inches in width, and 10 gauge minimum steel for panels exceeding 42-inches in width. Panel subplates shall be the same gauge as the enclosure. Stiffening members shall be provided for strength and stiffness as required.

A minimum of 4-inches shall be provided between the edge of the panel subplate and the outside walls of the panel body to insure adequate wireway space for external wires entering the panel. The panel subplate shall be mounted on collar studs for easy removal. Print pockets shall be provided on each panel. Brackets welded to the inside of the panel, complete with lights, shall be provided on panels where indicated by the Drawings.

Identification plates shall be laminated phenolic, with white letters engraved on a black background, mounted with self-tapping screws or double back adhesive foam tape. All components on the subpanel shall have identification plates mounted below the respective device.

MISCELLANEOUS PRIMARY ELEMENT SCHEDULE

TAG	TYPE	Measured Medium	SIZE	RANGE	SIGNAL	REMARKS
LE-1	Ultrasonic Level	Waste filter Wash Water		24.5' - 9.5' (0 - 15')	SEE - LIT	Provide 30' cable to LIT1
LSH-1	Float cord type	Waste filter Wash Water				N.O. Contact - Provide wall brkt & 30' cord
LSL-1	Float cord type	Waste filter Wash Water				N.C. Contact - Provide wall brkt & 30' cord
LSM-1	Float cord type	Waste filter Wash Water				N.O. Contact - Provide wall brkt & 30' cord
						LSL-1, LSM-1, LSH-1 Form A3 Float Assembly. See drawings

MISC. SECONDARY ELEMENT SCHEDULE

TAG	TYPE	CASE	INPUT		CONTACTS		REMARKS
			Signal	Scale & Range	Low Level	High Level	
LI 1-1	Indicator	4" x 4" (ammeter)	4 - 20 mA	0 - 15'			
LI- 1-2	Indicator	3" x 6" (miniature)	4 - 20 mA	0 - 15'			
Provide one	(1) solid state	calibrator as specified:					

TRIP SWITCH SCHEDULE

TAG	SIGNAL OR TYPE	No. TRIPS	SET-POINT		DEAD BAND		OUTPUT		MOUNTING			REMARKS
			Screw	Knob	Fixed	Adjust.	SPDT	DPDT	Inside Panel	Flush	Wall WP	
LS 1-1	4-20mA	1		X		X		X	X			
LS 1-2	4-20mA	1		X		X		X	X			

SIGNAL CONVERTER SCHEDULE

TAG	TYPE	INPUT	OUTPUT	Enclosure NEMA			Mounting			REMARKS
				1	4	7	Integral	Wall	Panel	
LIT-1	Ultrasonic	0 - 15' (see LE-1)	4 - 20 mA		X			X		

15. PILING

SCOPE OF WORK

This work shall be subject to the conditions of the General Requirements and include the furnishing of labor, materials, tools, equipment, accessories and services necessary for providing and installing the items as shown on the Contract Drawings and/or as herein required.

Piling furnished and installed under this section shall be erected in full conformity with detail drawings, specifications, engineering data, instructions, and recommendation of the manufacturer as approved by the Engineer. Special attention shall be given to the General Equipment Stipulations of the General Requirements.

This work shall include all concrete work required to fill the steel casings, reinforcing steel inside the piles and load tests.

EXCAVATION, SHORING AND PUMPING

Excavation, sheeting, shoring and pumping are provided for under the heading of "Earthwork."

Excavations shall be made to the pile cut-off elevation before any piles are driven unless otherwise authorized by the Engineer.

PILES

All piles shall be cast-in-place concrete, formed by driving a steel casing and filling same with concrete. Piles shall have a safe load carrying capacity of 30 tons for bearing and 8 tons for uplift.

Cast-in-place piles shall be cylindrical and shall have steel sheels driven full length to the required bearing in intimate contact with the surroudning soil. The driven shells shall be left permanently in place.

The minimum outside diameter of cylindrical piles shall be 10¾ inches. If driven without a mandrel, they shall have a minimum wall thickness of 0.250 inches. All shells shall be of sufficient strength and thickness to withstand driving to the required resistance without injury and to resist harmful distortion.

DRIVING PILES

Before beginning work the Contractor shall submit details on the pile he proposes to furnish and a description of the proposed equipment and method of installation for the approval of the Engineer.

All piles shall be driven by such methods and equipment as will not impair their strength and will insure the pile shaft retaining the initial driving resistance and lateral support of the soil. Predrilling or augering for these piles is not permitted except for removal of obstruction.

In soils in which the driving of piles causes the points of previously driven piles to heave, special consideration shall be given to the sequence of pile installations. In such cases, a typical pile in each area shall be checked by level and when pile point heave is indicated, all piles in the vicinity of the check pile shall be reseated or redriven to the required resistance.

Piles shall be driven with a variation from the vertical of not more than 1-inch per 5 feet of pile length, and a tolerance at the cutoff elevation of not more than 3-inches from the designed location. Piles damaged in driving shall be properly repaired or withdrawn or replaced.

The pile driving hammer shall be steam (air) operated and shall develop not less than 15,000 foot pounds of energy per blow.

Cushions or cap blocks shall consist of one solid block of hardwood of proper shape and dimensions to fit the hammer of laminated material properly designed to transmit the hammer energy efficiently. The grain of the block shall be perpendicular (parallel to the axis of the pile). If laminated materials are used, the strength of such materials shall be equal to or greater than hardwood. The use of wood chips, small wood blocks, shaving, rope, or any similar material which excessively dampens the hammer blow shall not be permitted. Details of cap block arrangements shall be submitted to the Engineer for approval before piles are driven. The continuous or frequent introduction of materials to cushion the hammer blows will be prohibited.

All piles shall be driven to a minimum resistance that will produce a safe bearing value of not less than 30 tons as determined by the following formula:

$$P = \frac{2\,W\,H \text{ for single acting steam hammers}}{S + 0.1}$$

$$P = \frac{2\,E \text{ for double acting steam hammers}}{S + 0.1}$$

In which:

- P = safe bearing value of pile in pounds
- W = weight of striking parts of hammer in pounds
- H = stroke of hammer in feet
- S = final penetration of inches per blow
- E = rated striking energy in foot-pounds

Should obstructions (including boulders or timbers) be encountered which prevent the pile from securing adequate penetration or cause the pile to drift from the required location, the pile shall be withdrawn and, if not damaged, be redriven in a location to be determined by the Engineer.

CONCRETE
Concrete for steel shell cast-in-place piles shall be Class A (minimum ultimate strength of 4000 psi at 28 days) as specified in "Concrete". Such concrete shall be carefully mixed and placed in the shells to the cut-off elevation in accordance with accepted engineering practice. The steel casing shall be cut-off level within one inch of the elevation shown on the drawings. No concrete shall be placed for any pile until the shell has been inspected and found to be free of water, debris, or other foreign matter, and no concrete shall be placed in any shell until the shells for all adjoining piles within a radius of 10 feet or effective pile heave range have been driven.

REINFORCING STEEL
Reinforcing steel shall be furnished and placed as shown on the drawings and as specified under "Concrete."

TEST PILES
The design load capacity per pile is 30 tons bearing and 8 tons uplift.

One test pile shall be placed under the pump room slab at location to be designated by the Engineer. Uplift load test only shall be performed on this pile.

The test piles shall be tested to twice their design loads in accordance with the procedure set forth under "Pile Load Test."

PILE LOAD TESTS
Static loading tests shall be performed; each test to 16 tons in vertical uplift load. These tests shall be conducted on a special test pile program before the regular piling program is to be started. The piles to be tested shall be placed at least one week before the loading test is conducted. High early strength cement shall be used in the test piles. The Contractor shall advise the Engineer of the earliest date on which the first loading test can be made. Additional loading tests may be required at the discretion of the Engineer as the job progresses, and equipment for this purpose shall be provided by the Contractor. The Contractor will be compensated for such additional tests as an extra to the contract as set forth in the proposal. A sufficient number of anchor piles or reaction ballast may be used to supply the total reaction required for the pile tests. Details of the anchorage and testing equipment shall be submitted to the Engineer for approval as soon as possible after the contract has been awarded.

The load shall be applied to the pile by means of a hydraulic jack or battery of jacks equipped with a pressure gauge reading in convenient units and recently calibrated to insure maximum accuracy in controlling load increments. The load shall be applied in eight (8) equal increments up to the designated total load, or as otherwise designated by the Engineer, and at equal time intervals of one hour until the maximum load has been applied. The maximum load shall be maintained for a period of not more than 24 hours nor less than one hour, unless rapid progressive uplift or excessive total uplift requires departure from the selected procedure. The load shall then be decreased in equal increments of 25 percent of the total load, in equal time intervals corresponding to the time intervals used for the increasing loading cycle, until all load has been removed and the rebound measured. If the pile has not definitely sustained the specified test load without measurable progressive uplift, and at the discretion of the Engineer, repetitive load cycles may be required to definitely establish whether or not the specified test load can be sustained without continued permanent settlement or uplift.

Uplift readings are to be made with dial gauges accurate to .001 inch and independently supported so as to be free from the influence of movements of the test pile, reaction ballast or the anchor piles. Uplift readings shall be taken and recorded immediately before and after application or release of each load increment and at ten-minute intervals between load increments.

The record of observations from loading each test pile along with a complete pile driving record shall be submitted to the Engineer upon completion of each test for plotting and determination of the load carrying capacity of the pile. The ultimate capacity of the pile shall be defined in these tests by any one, or the average, of the following determinations, whichever is judged by the Engineer to be the most representative under existing conditions:

1. The yield value, or load at which progressive uplift occurs, as determined by extrapolation of the rates of movements for each load increment.

2. The load carried at a movement equal to the measured elastic deformation or rebound.

3. The repetitive load at which there is no further permanent deformation, or at which the rebound approached 100 percent of the measured movement.

Repetitive loading cycles are normally required only under conditions in which the determinations under (1) and (2) are inadequate.

Test piles, if not adamaged in the testing, may be used as regular piles.

BASIS OF PAYMENT

Payment will be made on a lump sum basis for the load tests and the number of piles shown on the Drawings

having the estimated lengths set forth in the Proposal. If the total length of piles, as furnished and actually placed, is greater or less than the base length, the lump sum price will be correspondingly adjusted under the appropriate until price for increasing or decreasing the aggregate length of piles furnished and placed. If additional load tests are performed, payment will be made for each additional test as set forth in the Proposal.

The pay length of each pile shall be that length measured from point to the cut-off. No payment will be made for withdrawn, broken or rejected piles. No payment will be made for cutting off the piles or for any portion of the pile remaining above the cut-off elevation.

The adjusted lump sum payment shall be payment in full for funishing at the site all sleeves, reinforcing steel and all other materials required? and for furnishing all material, labor, tools, equipment and incidentals necessary for performing all required augering, furnishing the mortar, filling the casings or holes with mortar, including reinforcing steel and top anchor plate, and the performance of the load tests.

City Clerk Memorandum

CHARLES W. WESTERMAN, Clerk

To Mayor Robert E. Armstrong Date 12-7-77

From Charles W. Westerman - City Clerk

Subject Appearance before Common Council - 12-13-77

COPIES TO:

BILL NO. S-77-11-44

AN ORDINANCE approving a contract with Hagerman Construction Corporation, for Water Works Improvements Wash Water Retention Basin Contract No. 77-W-1

Pursuant to the request of the Standing Committee Chairman of City Utilitities of Common Council, the presence of Henry P. Wehrenberg - Chairman of the Board of Public Works, is respectfully requested on December 13, 1977, at 7:00 P.M., Room 128, Common Council Conference Room.

Further information is requested by Common Council regarding the Water Works Improvements Wash Water Retention Basin Contract No. 77-W-1 - Hagerman Construction Corporation.

Your cooperation will be greatly appreciated.

C. Bemicke

12-7-77

Rm 3

CONTRACT #77-W-1

TITLE OF ORDINANCE SPECIAL ORDINANCE - WATERWORKS IMPROVEMENTS WASH WATER RETENTION BASIN

DEPARTMENT REQUESTING ORDINANCE BOARD OF PUBLIC WORKS S-77-11-44

SYNOPSIS OF ORDINANCE WATERWORKS IMPROVEMENTS WASH WATER RETENTION BASIN CONTRACT #77-W-1 WITH HAGERMAN CONSTRUCTION CORPORATION, CONTRACTOR FOR THE PROJECT IN THE AMOUNT OF $540,600.00

(CONTRACT #77-W-1). INCLUDED HEREIN

PRIOR APPROVAL REQUESTED 11-10-77

EFFECT OF PASSAGE ELIMINATE DISCHARGE OF THE FILTER BACKWASH WATER BEING EMPTIED INTO THE RIVER IN FRONT OF THE THREE RIVERS FILTRATION PLANT THEREBY POLLUTING THE RIVER

EFFECT OF NON-PASSAGE VIOLATION OF STREAM POLLUTION CONTROL BOARD CONSTRUCTION DEADLINE OF DECEMBER 1, 1977 UNDER INDIANA CAUSE NO. B-437

MONEY INVOLVED (DIRECT COSTS, EXPENDITURES, SAVINGS) $540,600.00 FROM WATER UTILITY

ASSIGNED TO COMMITTEE

EP

Cap Matter